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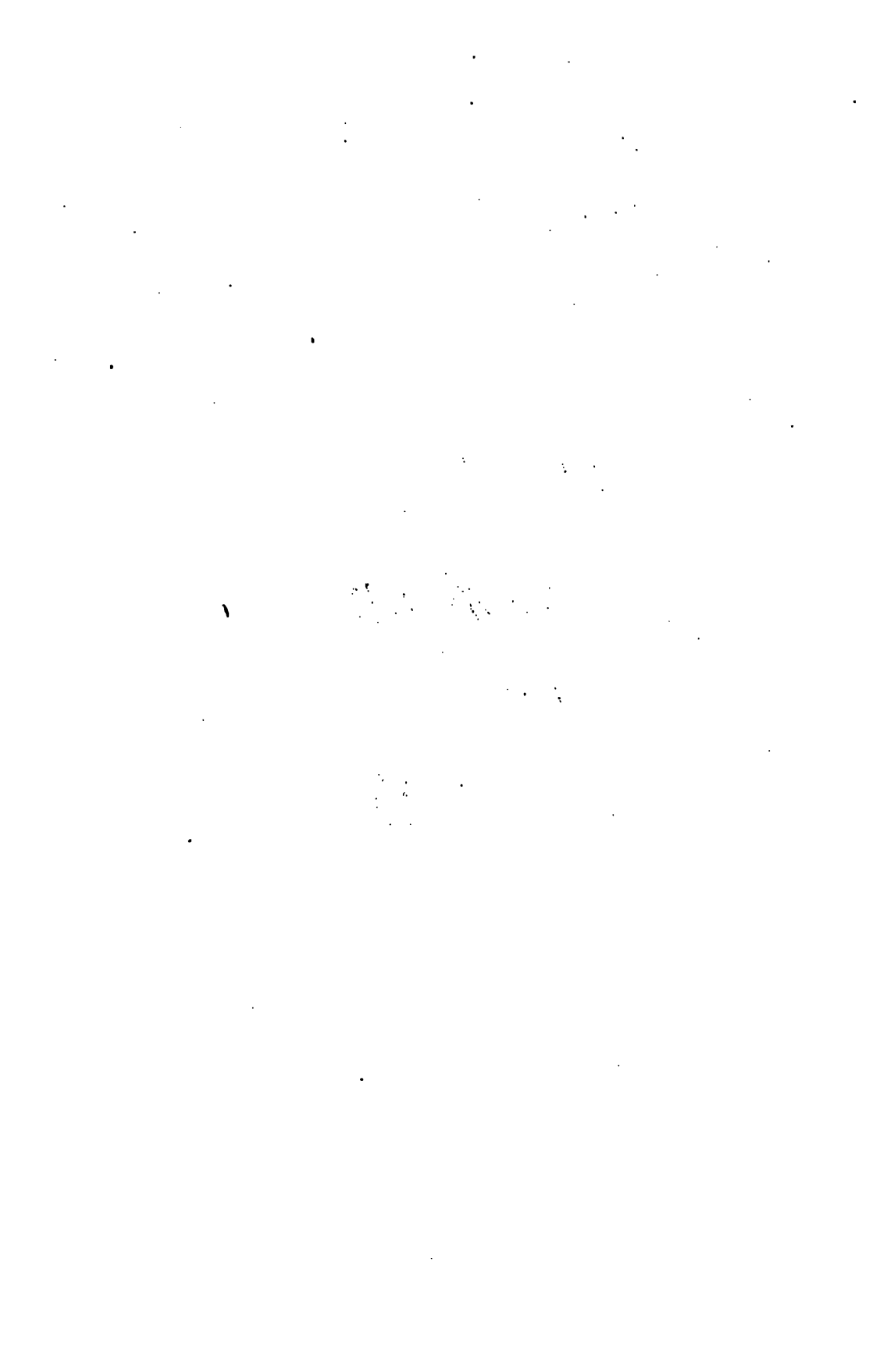
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# *Highways Green Book*

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1922

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**THE AMERICAN AUTOMOBILE ASSOCIATION** is the National organization of motor car users. It was organized in 1902, and has a membership of over 230,000, subdivided into State and local clubs, and individual members. Its main objects, briefly stated, are:

- TO UNITE** in one body all the automobile clubs and individual motorists of the country.
- TO SECURE** reasonable and just legislation and to aid in proper enforcement of automobile laws and ordinances.
- TO OBTAIN** local, State, and Federal aid in the construction and maintenance of good roads.
- TO ENCOURAGE** road travel and transportation, and to secure, prepare, and disseminate information relative thereto.
- TO SUPPORT** sportsmanlike contests and other movements that will advance motoring interest.

## A. A. A. GOOD ROADS WORK

**T**HE serious participation of the A.A.A. in roads matters began with the convention conducted by the Automobile Club of Springfield, Mass., September 24-25, 1907.

In July, 1908, the first A.A.A. National Roads Convention took place in Buffalo.

In September, 1909, the second A.A.A. National Roads Convention was held in Cleveland, co-operated in by National Grange and American Road Makers.

In September, 1910, the third convention was held in St. Louis, co-operated in by National Grange and American Road Makers Association.

In 1912, at Atlantic City, N. J., the A.A.A. co-operated with the American Highway Association in the holding of the American Road Congress.

Again in 1913, at Detroit, and in 1914, at Atlanta, this co-operation with the A.A.A. was continued.

The American Automobile Association conducted the first Federal Aid Convention in Washington, D. C., January 16-17, 1912, following which came the creation of the Joint Committee of the Senate and House, authorized to investigate the desirability and feasibility of Federal aid to the States.

The second Federal Aid Convention called by the A.A.A. was held in Washington, D. C., March 6-7, 1913, and in its wake came a Committee on Roads in the House of Representatives.

Federal legislation was not secured in the Congress of the winter of 1914-15 because the House of Representatives passed one measure and the Senate committee reported a substitute bill.

The first step toward a comprehensive Federal plan was enacted into law by the 64th Congress known as the Bankhead-Shackleford bill and approved by President Woodrow Wilson, July 11, 1916. The American Automobile Association and the American Association of State Highway Officials led the effort for this measure, which carried with it an appropriation of \$85,000,000, to be expended in the succeeding five years, with \$75,000,000 contributed by the several States.

In the third session of the 65th Congress, the A.A.A. and other organizations urged a substantial appropriation to the Federal Aid Road Act, and in February, 1919, Congress added \$200,000,000 to be distributed and expended as before among the several States and requiring from them a like amount. Furthermore, \$9,000,000 was added to the previously appropriated \$10,000,000 for roads in Federal Forest reserves. In the 67th Congress the A.A.A. worked for a Federal highway system to be built under Federal direction which resulted in a compromise providing: 1. That all future Federal aid be confined to definite system of not over 7% of the highways in each State; 2. Generous and just relief to Western States containing large areas of Government land; 3. An appropriation of \$75,000,000 Federal aid for one year and \$15,000,000 for forest roads for two years; 4. Adequate provisions insuring maintenance of Federal aid projects.

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## Foreword

TO combine in one volume a compendium of the outstanding highway activities of the past year and a forecast of the future is the object of the Highways Green Book.

Doubtless the most noteworthy highway achievement of 1921 was the passage of the Federal Highway Act which for the first time confines Federal aid road funds to a definite system of inter-state and inter-county roads comprising not over seven per cent of the total mileage in each State and which at the same time provides at the suggestion of President Harding, a plan by which these roads are to be adequately maintained. Thus the most important milestone in our highway history has been passed.

Unusual progress was made last year in the matter of highway research and highway engineering and transport education. Forward legislation in a number of States looking to more efficient administration of highway affairs, a larger measure of centralized control and greater revenues from bond issues and taxation has been adopted. These subjects and many others of interest to students of current highway legislation, economics, taxation, progress, construction, maintenance and transportation are ably treated in the pages of this book by the best known highway authorities in the country.

The Chairman of the A. A. A. Good Roads Board believes that this book is a veritable storehouse of information on nearly every important phase of the subject of highway development and that it will, therefore, appeal to public speakers, legislators, college and high school students, newspaper and magazine writers, automobile and commercial clubs, good roads associations, manufacturers of road building machinery and materials, contractors, public spirited citizens and above all motorists.

The Good Roads Board of the A. A. A. gratefully acknowledges its indebtedness to all those who have in a broadminded spirit of cooperation contributed their time and effort to make the 1922 edition of the Highways Green Book a success.

A. A. A. GOOD ROADS BOARD.

M. O. ELDRIDGE,  
*Secretary.*

H. G. SHIRLEY,  
*Chairman.*



**PART I**  
**Information Relating to Road Improvements Under**  
**Federal, State and Local Control**





HON. CHARLES E. TOWNSEND

*The enactment into law recently of the so-called "Federal Highway Aid Bill," carrying an appropriation of \$75,000,000, and special appropriations for forest roads and trails, marks a signal victory for Senator Charles E. Townsend, Chairman of the Senate Committee on Post Offices and Post Roads, and leader of the good roads advocates in the Senate. Confronted by the urgent need for economy and by opposition and indifference, not only to his particular views but to Federal participation in road construction as a principle, he and his associates overcame what appeared to be insurmountable obstacles by the ultimate passage of the bill containing so many of the principles which he advocated.*

## THE HIGHWAY SITUATION<sup>1</sup>

By HON. CHARLES E. TOWNSEND

*Chairman of the Committee on Post Roads of the Senate of the  
United States*

THIS is the Motor Age. We have passed through 75 years of national development, during which the main factor has been the railway. The areas and zones in which the highest development has been attained are the areas and zones supplied with railways. The railways will continue to be a vital factor, yet during the next 75 years the main factor in our advance will be the highway. If this be true there is nothing of greater importance to engage the thought and effort of the governments, Federal, State, county and municipal, than to put the highways of our country in condition to meet the requirements of the spirit of the age in which we live.

Compared with England, France and some other European countries, the United States occupies an inferior position in the matter of highways. Many years ago they built their roads, good roads everywhere, from the capital city and metropolis to every city and town and hamlet in the land. When constructed, these roads were cared for, scientifically and unceasingly, so that they were always in perfect condition. Since the signing of the armistice, they have expended vast sums in repair and in rebuilding the war-worn and shell-torn roads and, in addition, France has built great military highways extending toward the Ruhr Valley.

Turning to the roads at home, what do we find? Two hundred and fifty thousand miles of roads which may be classified as fairly good and two million two hundred and twenty-five thousand miles of inferior roads. Speaking in general terms and of average conditions, we travel one mile out of town on a good road and the next nine miles on a wagon trail which is muddy in winter and dusty in summer.

What was it which enabled us to take such a decisive part at Chateau Thierry in the supreme moment of the world war? The motor truck on the roads of France. The Germans had driven the point of the wedge between the English and the French, the way to the English channel was open. Forty miles away were thousands of U. S. Marines and other troops. They climbed into those trucks. They flew over those splendid roads. They arrived on

<sup>1</sup> Reprinted from March number of *Motor*.



time. They checked the foe and that was the farthest west the Germans ever got. Should such a situation occur in the United States, would the Convoy arrive on time?

During the summer of 1919 the War Department sent an army expedition by motor vehicles from Washington to San Francisco and the following summer a similar expedition was sent from Washington through the South to Los Angeles. Both failed to reach their objectives on time. Both proved that roads, bridges and culverts were too weak and too narrow and that the army could not be moved by motor convoy over dirt roads after heavy rains. And the miles of roads better than dirt are expressed in hundreds of thousands and the miles of dirt roads are expressed in millions. Is the United States safe?

Can any other term than bad be applied to the situation when one reflects that it is costing us fully three times as much per mile to move American goods over the highway-end of the journey from the farm to the markets of the world as it costs our competitors for those markets?

When we speak of the highway situation in our country as bad, we must qualify. Conditions are much better north of the Potomac and the Ohio and east of the Mississippi, and in Florida and west of the Rockies than elsewhere. However, even in the most progressive sections the mileage of improved roads is small when compared with the mileage of roads of a type which belongs to a day that is dead.

Why do we insist that the situation is bad? Principally, though not altogether, because of the gas engine and its utilization as the power unit of a vehicle. History shows that when the Almighty seeks to impart an impulse to human progress he usually puts into some human brain a notion that leads either to a discovery—Christopher Columbus, for example,—or to an idea that blossoms as an invention, like the reaping machine, the application of steam to transportation, and a dozen others. Among them all there is none that has imparted, or is destined to impart, a mightier impulse to human progress than the motor vehicle. However, the motor vehicle requires for its efficient and economic operation an adapted track, as much so as does the railway locomotive, the only difference being that an automobile can be operated on a wagon road and the locomotive, by reason of its weight, cannot.

When we built our railroads, we first built the grade, laid the ties and spiked down the rails; and then and not until then did we purchase the rolling stock and put it into commission.

In developing motor transportation, however, we have reversed the order; we have purchased our rolling stock, an intricately constructed and costly mechanism, subject to serious injury with rough usage, and we have put it into commission before constructing a

proper track for it to run upon; we have put it into commission on tracks built for much lighter and totally different type of vehicle, the buggy and the wagon. The result is that the efficiency of a transportation facility almost 100 per cent efficient in itself is cut down by use of non-adapted roads to less than half its value, and there are doubtless considerable areas in the United States where a loss in efficiency amounts to as much as 75 per cent.

On an improved road one can now travel by automobile in comfort and at moderate cost at 20 to 30 miles per hour instead of formerly at 4 to 6 miles an hour. Goods can be moved at 15 to 25 miles per hour instead of by wagon at 2 to 3 miles per hour. Thus it follows that the way to progress is to build the motor track and that until we do so we are losing more than half the value of our most valuable instrument of progress.

In urging such a policy of road construction, however, I am not unmindful of the colossal cost. Of course, we understand that it will not be necessary to spend as much on a road from a county-seat to the county line in a sparsely settled section as on a main trunk line road in a densely populated region. Yet the cost of building and properly maintaining the roads of the United States so as to put us on an equality with England and France will run into many billions of dollars. One who advocates such an expenditure must show the taxpayer that his interests necessitate such a course.

That the people of the United States will not hesitate to build proper tracks on which to run their cars even though the expense of such a road is vastly greater than the expense of a wagon road is evident from the fact that the cost of a motor truck or an automobile is vastly greater than the cost of a wagon, team and harness. How many motor vehicles have been bought that now rest in the junk pile no one knows, but the latest census shows *ten million now in commission* representing *an investment of at least ten billion dollars*.

Since the buying public is willing to pay so much more for a superior transportation unit, the buying public is not going to hesitate to go to the expense of paying the increased price of the superior road called for by the superior vehicle, especially when the cost of the modern highway is a mere bagatelle compared with the appalling loss and waste due to the anachronism of modern motorized America trying to do business over primitive wagon trails of a type long ago discarded by other civilized nations.

The annual depreciation on vehicles due to inferior roads doubtless amounts to more than the total annual expenditure for highway construction and maintenance by all the Federal, State, county and municipal agencies combined. This is only one item showing the actual money loss which results from the operation of motor and



other vehicles upon non-adapted roads. Another item worthy of consideration is the loss of time resulting from the slow movement of freight and passengers over primitive roads as compared with the more rapid transit which would be possible if our roads were modernized.

Deplorable as is the situation, it is improving more rapidly than either water or rail transportation. Improvement would have been much more marked had it not been for the solar-plexus blow delivered to ourselves and the rest of the world by the great war.

Realizing the seriousness of the situation and that the municipalities, the counties and the States combined could not cope with it, the Congress of the United States in 1916 enacted the Federal Aid Road Act, under which it proposed a partnership with the States in road building on a basis of cost sharing and made appropriations for the Federal share of costs on a five-year construction program.

Before the cooperative plan was well under way, we entered the war and only essential things were done until hostilities ceased. Our roads, excepting such as were essential for war activities, were neglected, our thoughts were overseas, whither we sent our engineers, our transits and our cash and our war loans, the latter amounting with accrued interest to about \$11,000,000,000.

Hostilities having ceased, Congress made additional appropriations of \$209,000,000 for highway improvement during the three years remaining of the five-year construction period. In addition, Congress moved to remedy conditions by legislation under which some \$150,000,000 of left-over war property, such as motor trucks, tractors, road machinery, and other road building equipment, have been shipped gratis to the States for highway work. It is believed that this equipment has done more to expedite the work than has the money appropriations. The new Federal Highway Act broadens and strengthens previous legislation on this subject.

The aftermath of the war, the coal strike and the embargo on shipments of road material and equipment, the disruption of contractors' organization by the war, the shortage of labor and the abnormal cost of construction has delayed the program, so that until recently it has not been a question of having enough money available to build roads with, it has been a question of how to get it spent. This condition will soon change, in fact, in several of the States whose need is great, the shortage of funds is even now delaying construction.

All things considered, much progress has been made during the five-year period which ended last June. While the actual increase in the mileage of improved roads was not great, a notable advance has been made in the type of construction, although this must be said with some reservations due to the fact that in certain States the people have not as yet been educated to the point of realizing

that the costlier roadways are generally the cheaper in the long run. In some States, highway bonds have not yet been liquidated, the proceeds of which were used to build water-bound macadam roads which have been once, and in some instances, twice rebuilt and which are now worn out.

The five-year period expiring in June last, Congress had to choose between withdrawing from the partnership or making a fresh appropriation. Hearings were conducted and the excellences and defects of the existing Federal aid plan were revealed. Both were found to exist, the former in such marked degree that Congress decided to continue the coöperative plan with certain amendments calculated to remedy the defects.

The amended road act is the result of an earnest effort to remove political interference from the field of highway improvement, and to secure connecting and continuous roads of a durable type. It represents a distinct advance. The sum of \$75,000,000 was appropriated on November 2, 1921, for the eight remaining months of the fiscal year ending June 30, 1922, with \$5,000,000 for National forest roads during the remainder of the current fiscal year and \$10,000,000 for the fiscal year ending June 30, 1923.

Under the original legislation, it had been possible to apply Federal road funds to the construction of roads of mere local importance, political roads running by somebody's front door, but beginning nowhere and going nowhere. In instances, roads of an expensive type were built with the aid of the Federal Government, which runs a few miles out of town and which may never be extended, with an equal type of construction. The temptations to resort to the pork barrel was so great that, unless the law had been amended to curb this tendency, road legislation in Congress would have run the down hill course that rivers and harbors legislation has run and in a few years would have ceased entirely.

The fact that in the future all Federal appropriations must be expended under the direct control of the State Highway Departments, with the approval of the Secretary of Agriculture, seems to effectually eliminate the possibility of local politics entering into road problems.

Henceforth, the Federal funds must be confined to an Inter-state System of roads a total of seven per cent of the entire road mileage of the State, three per cent to constitute a primary and four per cent a secondary or inter-county system, the former to have a degree of priority to right of construction. This will result in hastening the completion of roads that begin somewhere and go somewhere and that will render the maximum of highway service. Preference shall be given to the primary system of inter-state roads but not more than sixty per cent of the Federal aid allotted to each State may be expended upon this system except on the approval of the State Highway Department.



Another improvement is that requiring the States as such to assume responsibility for the construction and maintenance of the Inter-state systems, instead of passing the responsibility, in whole or in part, to the counties. It will no longer be possible in certain States for rich counties to match practically all of the Federal aid allotted, thus depriving the poorer counties of their share in road improvements.

The new measure also carries a provision which guarantees adequate maintenance of the roads when constructed, one of the most important changes. Enforced maintenance, which in the past has been such a crying need, is now provided for with respect to all roads upon which Federal money has been expended.

The labor necessary in road construction and maintenance must have its present effect in alleviating to some extent the unemployed situation, and with a connected system of highways which we are hopeful will be constructed, much of the terror in the event of a railroad paralysis will have been removed.

Of great advantage to the Western States is the increased appropriation for National forest roads, for road buildings across Indian Reservations and a provision whereby the Federal Government does not require the States having large areas of public lands to bear one-half of the cost of coöperative roads, but a lower percentage due to the fact that the State derives no revenue from the Federalized areas.

It has always been my position that the principle of Federal participation in the construction of certain roads should be accepted as axiomatic. In my original bill which provided for a Federal Highway Commission to administer Federal appropriations and deal with highway problems, I provided that Federal money should be expended only upon inter-state roads. With the completion of the connecting backbone system the Federal money then could have been used to construct the ribs branching out through the counties.

Much disappointment was felt that a smaller amount was appropriated than had been made available for the year ending last June, also that provision was made for only a single year, instead of for a five-year period. On the basis of \$80,000,000 for the remaining eight months of the current fiscal year, Congress is continuing to maintain a high level of appropriations for highways. Furthermore, it must be remembered, that the war has hurled humanity back, perhaps a generation or more. There has been an appalling waste of man-power and of wealth. Congress would doubtless now be appropriating much larger sums for roads did it not have to pay interest on the Liberty Bonds and provide for their liquidation, and were it not for the withdrawal of \$10,000,000,000 which we loaned to our Allies. Our brave Expeditionary Force has returned, those who survived, many of them maimed, their earning power de-

stroyed or reduced; these and the widows and orphans must be cared for. In such circumstances Congress has to feel its way along.

Where are the billions to come from with which to pave the United States? We will be in a better position to answer this question after the sittings of the Conference on Limitation of Armament and after the War Debt Funding Commission has made its report.

Just at present Congress is compelled to appropriate some \$3,600,000,000 per annum for the military establishment which may be considered in contrast with a modest \$80,000,000 for highways. It may eventuate that it would be deemed good statesmanship to transfer some nine figure totals from the former to the latter.

The ability of Congress to make the appropriations which the highway situation requires will depend in large measure upon the attitude assumed by the Allies in regard to repayment of the War Loans. When they begin to make interest payments, some of our frozen assets will become liquid, and what better use could be made of some of this money as it flows back from overseas than to expend it in building highways at home such as we found abroad? There may be some prior obligations to which a portion of this fund should be applied; but after such are discharged, it would not be illogical but rather would be conducive to international good will, if it should come to pass that the war resulted in the paving of the United States.

In casting about for the funds wherewith to end the era of mud and dust, discerning eyes will discover in the mud-holes, the deep-cut ruts and the dust beds the coin with which to displace them with modern highways. The coin, good coin of the realm, is being deposited there, dropping off with every turn of every wheel. Is there not enough ingenuity with us to discover a way to shunt this rattling coin into a strong box labeled "Highway Fund?" If that waste can be transformed into an investment, America will soon be doing business, not just "as usual," but beyond anything in her history.

What is the next step? The Federal and State Road Agencies should coöperate to realize the maximum benefit in the administration of the amended law and the funds entrusted to them. In addition Congress should act early in the coming year to make further appropriations, not less than \$100,000,000 a year with additional sums for forest roads; and this should, in my judgment, be on a five-year program.

Those States which now depend upon counties, townships or districts to produce the funds with which to meet the Federal aid should without further delay provide adequate *State* funds with which to match the Federal aid and for the maintenance of all Federal aid highways which now becomes a *State* obligation.



A hopeful feature of the situation is the spirit of coöperation that seems to have superseded the divided counsel that has worked injury to the Good Roads cause. It is going to take the combined wisdom of all, in whole-hearted coöperation, to develop a highway transportation system which will give the proper highway service in a country extending over an area so vast as ours.

I am confident that with the coöperation between the Bureau of Public Roads and the several State Highway Departments which is so essential, great strides in highway construction will be made. There is ample power in the law to ultimately secure the results which the friends of good roads have so long striven for. I regard this new law as one of the most progressive steps looking toward internal improvement ever taken by the Congress.

It is going to take a well-filled purse to finance the program laid down by Congress. With other construction work to be done, calling for contractors and laborers, it is going to be difficult to build roads as rapidly as the situation requires. Nevertheless, one thing should be patent to all; the United States that most of us in Congress have to deal with is not the United States as it will be revealed in the census of 1940. It will be the United States of the census of 1930 and that is in the making now. It would be some satisfaction to many of us to see our country modernized for highway service while we are here to witness and enjoy the benefit of such a result.

## HIGHWAY ACHIEVEMENTS AND PROSPECTS

By THOS. H. MACDONALD,  
*Chief, Bureau of Public Roads*

THE story of American highway development as it has been written thus far contains at least three significant dates. They are the year 1891, in which the first State aid law was passed in New Jersey, July 11, 1916, the day on which President Wilson signed the Federal Aid Road Act, which brought the Fed-



HON. T. H. MACDONALD

eral Government into active copartnership with the States, and November 9, 1921, when the passage of the Federal Highway Act laid the basis for the building of an inter-state or National highway system.

It would be difficult to decide which of the acts which distinguish these dates has had or is destined to have the greatest and most far-reaching influence upon the progress of highway building and highway transportation in the United States.

The organization of that first highway department in the State of New Jersey was the first great experiment in the series of departures from accepted principles which have lifted the highways of the nation from the plane of local mismanagement to that of scientific control and development on a State and national basis. It proved to be a distinctly successful experiment not only in the pioneer State, but in each of the 30 States which year by year, and one by one recognized the benefits of the new plan and adopted it, prior to 1916.

In one sense the participation of the government, secured through the passage of the Federal Aid Road Act in that year was not so much an experiment as an extension of the benefits of the plan of State control, by effecting the organization of highway departments in the remaining 17 States. In the long run the creation of these State departments and the strengthening of others will prove to be the most important of the results of the act—more important even than the thousands of miles of road which have been improved with the money appropriated. The increase in the proportion of work conducted under the control of the States from 27 per cent to 80 per cent in the space of less than six years is an accomplishment of fundamental importance and the effects of that accomplishment of the Federal Aid Road Act will be felt long after the immediate benefits of the roads improved have been forgotten.

In another sense the first Federal act was decidedly an experiment, and one which happily has proved as successful as the first. I refer to the very great degree of accommodation and coöperation required of the States and Federal Government. While the principle of Federal grants in aid was not applied for the first time in the Federal Aid Road Act, no preceding coöperative measure had called for the same degree of mutual good will and forbearance. Roads had previously been held to be the peculiar concern of the locality, and even the transfer of control from the counties to the States had met with strong opposition. Five years ago the idea of a national system of roads met with no practical acceptance, as twenty years ago the conception of State roads was beyond the vision of a people as local minded in all that affected the development of their highways as their ancestors a century before. The complete removal of these old barriers of local prejudice and the upbuilding of an association of State highway departments working in close coöperation with the Federal Government through the Bureau of Public Roads, is the happy result of five years' experiment and development under the Federal Aid Road Act.



We are now fairly launched upon our third great experiment under the Federal Highway Act which was approved last November, and again the experiment is evolutionary in character rather than revolutionary. The first act built up a great Federal and State coöperative organization for the building of highways, and provided for the combined organizations the means with which to test their capacity and efficiency by practice. The new act corrects the few defects that were found in the five years of trial and lays down a program for the construction of a great system of interstate and inter-county roads. As we set out to follow the program planned for us we look forward to the time not far removed when we shall have a National system of connected roads, each road a link in the National chain, bearing its due proportion of inter-state traffic, yet each a local road as well, serving with well placed lateral roads to distribute and collect the traffic of the rural sections.

The passage of this act with its provision for systematic development of our highways on a National basis and the emphasis it lays upon the duty of maintenance is the greatest highway accomplishment of the past year, transcending in importance even the magnificent advance which has been made in construction. The most important duty of the coming year is that of laying the foundation upon which the systems required by the law will be built up.

There can be no doubt as to the clear intent of the law to provide for a system of roads which shall include those which are now and which after improvement will become the major traffic lines. But we must not minimize the importance of local traffic. In carrying the terms of the act into effect our conception should be that a choice of highways shall be made which, regardless of the order of improvement, will eventually join into a well conceived network crossing both county and State boundaries. Thus, while the immediate need of a State or a district may determine the priority of construction, each new link will bring nearer the completion of the system as a whole, State and Federal agencies are a unit in their determination to work out the requirements of the law on substantially this basis, and we may confidently look forward to material progress during this year.

From the standpoint of construction and maintenance we have made greater progress in 1921 than in any previous year. Approximately \$600,000,000 have been spent by National, State and local governments, about \$420,000,000 for construction and \$180,000,000 for maintenance.

The set-back in the condition of the roads, resulting from lack of maintenance during the period of the war has been made up by increased maintenance and rebuilding, and our mileage has been extended so that the roads are in far better condition today than they have ever been in our history.

The Federal aid program has advanced with a rapidity little short of startling to those unfamiliar with the steady progress made in previous years in the preliminary stages of surveying and planning. In July, 1920, four years after the passage of the Federal Aid Road Act there had been entirely completed 1,677 miles of road and projects aggregating 14,940 miles were 30 per cent complete, making an equivalent completed length of approximately 6,000 miles. A year later and five years after the passage of the act the mileage entirely completed was 7,469 and the 17,978 miles under construction were 50 per cent complete, so that the equivalent completed length was over 16,000 miles, a gain of 10,000 miles during the year. In seven months after the last anniversary of the act, that is on February 11, 1922, the mileage of road entirely completed had increased to 13,867 miles, and including the completed portion of projects under construction there was an equivalent completed length of over 24,000 miles of road, or more than enough to encircle the earth at the equator. The total length of all projects approved up to the same date, including completed projects and projects in the construction and pre-construction stages, was 35,751 miles.

For the ensuing year the prospect is that the uncompleted work on the 15,000 miles of roads which are under construction will be dispatched promptly, and the 6,700 miles now in the pre-contract stages will be placed under construction and pushed to completion as rapidly as possible. But there will be no let-up in the energy with which the work will be prosecuted, the mileage opened to traffic may be expected to fall off on account of the delayed appropriation of funds in extension of the preceding appropriations, which operated to prevent the institution of new work last year.

The portion of the several appropriations, including the last, unobligated on January 31 was \$81,848,341. At the rate at which the money has been absorbed heretofore this amount would have been entirely taken up in approved projects in less than a year. On account of the time lost last year the rate will not be quite so great, but there should be no further delay in appropriating funds for the continuance of the program for at least another 5-year period.

In attempting to forecast the progress that will be made during the coming year there are a number of opposing factors to be considered, some of which operate to encourage an extensive program and others which tend to a limitation of our efforts. On the one side, as tending to promote a large program there are: (1) The recognized need of universal easy and cheap transportation facilities; (2) The known inadequacy of present highway facilities to meet the demands of the actual and potential traffic; (3) The proved benefits of the highways in return for the investment that



is made. On the other side, tending to limit the program there are: (1) The funds available; (2) The economic situation; (3) Prices and costs of highway improvement.

### **The Need of Universal Easy and Cheap Transportation.**

It is perhaps unnecessary to dwell on the needs for easy and cheap transportation. The improvement of our means of transportation as much as any other factor has been responsible for the economic growth of this country. A striking example of what the lack of transportation may mean to a nation is afforded by the deplorable condition of China. When, recently, there were thousands starving in parts of that country and food was being sent from America, there was excess production of food in other provinces of the same country that could not be obtained because of lack of internal transportation facilities. In the United States our railroads alone would save us from such extreme disaster, yet we have come to a realization since the war that even our highly developed railroad transportation system is not sufficient to meet the needs of our people. We have seen corn burned as fuel in place of coal because of a transport barrier raised between the producers and the consumers of corn and coal, and it has been brought home to us that adequate transportation is as necessary to the prosperity of the United States as ample production.

### **Belated Response to Demand for Highways.**

Every automobile and every motor truck that has been added to the registration books in a score of years has added to the strength of the demand for suitable highways. While there is perhaps no close relation between the rate of increase of these vehicles and the rate at which we should add to our highway facilities yet the fact that we now have 10,000,000 motor vehicles in need of suitable highways upon which to operate is the sufficient reason for our determination as implied in the Federal Highway Act to build up in this country a great net-work of roads penetrating to every section. There is need at once for the entire system; it could not be more acutely felt had we twenty million potential users instead of ten. There was practically the same need five years ago when we had less than four million, but we have just begun to comprehend their significance and to translate our understanding into action. We are making a belated response to the demand they present for connected highways upon which to operate, and because we have delayed there is the greater reason for an accelerated rate of construction.

### Highway Benefits Proved.

We are convinced that we shall benefit by the construction of these roads. We do not need to seek that benefit along the indirect route of property value enhancement, we find it in the direct use we are able to make of the roads themselves. We find it in the multiplied traffic that passes over our modern roads, in the fleets of motor trucks plying between cities carrying commodities from the producer directly to the consumer, in the farm trucks loaded down with the fruit of the soil moving from the farm to the market, in the growth of a passenger bus service that numbers vehicles by the thousand. Most strikingly we find it in a use of the highways by automobiles which, measured in passenger miles, is more than twice the service rendered by the railroads.

### The Response Limited by Funds Procurable.

Recognizing the need for improved transportation facilities and believing in the ability of the highways to provide the desired means, understanding that the need is the more pressing by virtue of our failure to heed the demand of close to a decade, there is every reason for an intensive drive to complete at least a minimum system of roads at the earliest possible moment. The rate at which we shall actually move toward that end,—the program for this present year and the succeeding year will be limited by the funds available, the funds procurable and the prices and costs of highway improvement. Our estimates of the amount of money available for 1922 are as high as \$720,000,000—from all sources, Federal, State and local. Very likely a portion of this money will not actually be available. The Federal portion can be definitely counted upon—the money is already provided and ready for immediate use. The portion which is to come from State bonds is probably equally certain, but I look for a probable decrease in the funds obtainable from local bond sources and from State and county taxes, on account of the generally unfavorable economic situation.

At the root of that situation is a particularly severe agricultural depression.

Forty per cent of our population is on the farms and more than 40 per cent of our buying power comes from these same farms. If the prices these people are receiving for their crops were such as prevailed in 1919 and the earlier part of 1920, they could pay increased rates without inconvenience, but they are not receiving such prices. If the prices of the things they need were low in proportion, there would be no embarrassment, but the trouble is that, whereas the prices the farmer receives for his crops are lower than before the war, the prices he pays for the things he needs are from 25 to 75 per cent above the pre-war level, hence the purchasing



power of the major farm crops is probably lower than at any time in our history, and this has very much to do with the nation-wide industrial and business depression. It has very much to do, as a matter of course, with the rate at which funds will be procurable for road construction when, as by our present methods, we are deriving fully 50 per cent of our construction funds from farm sources.

What those funds will buy in the way of highway improvement is the other limit placed upon our production of highways. In this connection there is a ray of hope in the reduced wage that has been accepted by labor. Wages paid on Federal aid projects in January are almost down to the pre-war level. The prevailing hourly rate in the East is 30 cents, in the South 25 cents, in the Pacific States 45 cents. These are but little higher than the standard wages of five years ago, and they are reflected in the reduced costs of grading and other operations which do not involve manufactured materials and transportation. The prices for certain classes of material and the freight rates have not come down proportionately, but the slight reduction that is observable, taken with the marked reduction in grading costs, has resulted in a very appreciable reduction in the cost of road building as a whole. The price reductions noted thus far and the generally upward tendency in the purchasing power of money lead me to the belief that we shall be able to carry on a program of construction and maintenance this year only slightly less extensive than that of last year, if it be not fully as extensive, and that we shall be able to do so with an appreciably smaller expenditure.



## TWIN GIANTS OF INDUSTRY

By CHARLES M. BABCOCK,

*President, American Association of State Highway Officials, and State  
Commissioner of Highways of Minnesota*

**G**OOD roads are the product of one of the greatest modern American industries.

Highway building and automotive manufacturing are the Siamese-twin giants of industrial America—closely linked enterprises running annually into billions of dollars—and important factors in the advance of civilization.

Future development of either is mainly dependent upon that of the other. Better equipped with motor vehicles than supplied with highway facilities, the public now is ready to speed road development. Automobile and truck owners generally accept the principle that wheels using the highways and demanding higher standards of construction and maintenance should bear a part of the greater expense and States are enlarging highway work programs toward meeting the reasonable demands of increasing motor vehicle traffic.

Highway executives are supplementing highway building and maintenance with a still broader service for users of public roads. Efficient highway administration no longer is confined to road construction and maintenance. Practical helps of many kinds are furnished highway users by the up-to-date highway organization. Its members from chief to common laborers regard themselves as salesmen of better roads and give to every passerby on the road the same service and courtesy the successful merchant accords his customers.

The highway department issuing road maps and condition bulletins and employing other agencies to make roads of easier and greater use to the public, supplies a service that always is appreciated and which builds sentiment for liberal highway appropriations.

That department inculcates in every member the realization that he is an employee of the public and the man who on occasion needs his special help is his particular employer. A maintenance patrolman makes a more cheerful road-tax payer and a more ardent good roads supporter of the man whose car he pulls back on the grade with an explanation that it is part of his work for which the car owner already has paid.

Greater public interest and increased funds provided for road operations have brought highway executives to a fuller appreciation of the responsibilities. The thinking commissioner and engineer now applies to the public's business the same effort and



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concern that he would to his own personal undertakings. This fact is reflected in recent comparisons of highway expenditures and improved mileages, general conditions considered.

Broad policies are beginning to afford maximum results and also to sustain public interest in highway development. The demand for more adequate highway facilities is almost universal in the United States and sectional considerations are fast disap-

pearing. Sectional lines well may be preserved, however, to create and promote healthy competition between States and communities.

Whether selfishness or disposition to fight for rights, a mighty force for good roads development is that which prompts the average man to see to it that his road is as good within reason as that by his neighbor's place. Contrasting conditions on an interstate highway divided by a line between States will quickly spur citizens in the State with the inferior mileage to end the unfavorable comparison. Public sentiment will force extension of the improvement over the entire interstate route and then to many secondary roads. The same will obtain on minor highways. For that reason, if for no other, local control will yield best results, especially if featured by the right supervision and methods. Federal and State aid plans, it has been conclusively demonstrated, are better advised than absolute control of different systems, except in a very limited number of cases.

United efforts should be put forth to obtain Federal highway aid in amounts increasing in proportion to the actual needs and the expenditures of local funds by the various States. The government will respond to a unanimous public sentiment in continuing and increasing financial assistance toward encouraging States to speed highway development. Some States are unable now to take full advantage of even current Federal aid, but if the allotments are continued, increased, and perhaps, made cumulative, these States will the sooner be listed for greater good roads achievements and the whole highway movement will be advanced accordingly.

Present Federal highway statutes, in my opinion, are ideal. They follow the most constructive lines and tend to influence the different States to adopt laws and plans which will produce the best results in the shortest time. I believe the consensus of opinion among State highway executives is that Federal legislation should take the lead, rather than slacken its pace to fit that of backward States.

The need now is for foresightedness. Adequate highways throughout the United States cannot be built in a year nor in five years. The public is willing to buy better roads and will continue that readiness just as long as it believes it is getting what it wants at reasonable prices. Caution should be exerted to preserve this public disposition.

Over-improvement of one road in a locality at the expense of others in need of betterments, highway officials have learned, makes knockers out of erstwhile good roads boosters. The average citizen stands for fair play and will give his support as quickly to a movement that operates in fairness as to one yielding him special benefits at the unjust expense of others.

Highway-users can make valuable contributions toward sustaining public sentiment now aligned behind the good roads movement. The truckman who overloads or otherwise unduly damages the road he travels is harming his own interest. Truck-builders also well may bear in mind this fact—the truck industry will thrive as public funds are forthcoming to extend adequate roads. But the average taxpayers will not stand for waste and will protest against taxation for building roads which are maltreated.

Highway officials, to use a commercial phrase, are jobbers of good roads and they will be successful in the measure they secure results for taxpayers and supply facilities required by highway users. Highway building is generally on a business basis—highway administration is becoming more and more separated from politics.

The fable of the Goose that Laid the Golden Egg must never be applied to the highway and automotive industries. These Siamese-twin giants must have the united coöperation of both highway and automotive men that they may live long and prosper.



## FEDERAL HIGHWAY ACT OF 1921

PUBLIC—No. 87—67TH CONGRESS. S. 1072.

AN ACT to amend the Act entitled "An Act to provide that the United States shall aid the States in the construction of rural post roads, and for other purposes," approved July 11, 1916, as amended and supplimented, and for other purposes.

**B**E IT enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the Federal Highway Act.

SEC. 2. That, when used in this Act, unless the context indicates otherwise—

The term "Federal Aid Act" means the Act entitled "An Act to provide that the United States shall aid the States in the construction of rural post roads, and for other purposes," approved July 11, 1916, as amended by sections 5 and 6 of an Act entitled "An Act making appropriations for the service of the Post Office Department for the fiscal year ending June 30, 1920, and for other purposes," approved February 28, 1919, and all other Acts amendatory thereof or supplementary thereto.

The term "highway" includes rights of way, bridges, drainage structures, signs, guard rails, and protective structures in connection with highways, but shall not include any highway or street in a municipality having a population of two thousand five hundred or more as shown by the last available census, except that portion of any such highway or street along which within a distance of one mile the houses average more than two hundred feet apart.

The term "State highway department" includes any State department, commission, board, or official having adequate powers and suitably equipped and organized to discharge to the satisfaction of the Secretary of Agriculture the duties herein required.

The term "maintenance" means the constant making of needed repairs to preserve a smooth surfaced highway.

The term "construction" means the supervising, inspecting, actual building, and all expenses incidental to the construction of a highway, except locating, surveying, mapping, and costs of rights of way.

The term "reconstruction" means a widening or a rebuilding of the highway or any portion thereof to make it a continuous road, and of sufficient width and strength to care adequately for traffic needs.

The term "forest roads" means roads wholly or partly within or adjacent to and serving the national forests.

The term "State funds" includes for the purposes of this Act funds raised under the authority of the State, or any political or other subdivision thereof, and made available for expenditure under the direct control of the State highway department.

SEC. 3. All powers and duties of the Council of National Defense under the Act entitled "An Act making appropriations for the support of the Army for the fiscal year ending June 30, 1917, and for other purposes," approved August 29, 1916, in relation to highway or highway transport, are hereby transferred to the Secretary of Agriculture, and the Council of National Defense is directed to turn over to the Secretary of Agriculture the equipment, material, supplies, papers, maps, and documents utilized in the exercise of such powers. The powers and duties of agencies dealing with highways in the national parks or in military or naval reservations under the control of the United States Army or Navy, or with highways used principally for military or naval purposes, shall not be taken over by the Secretary of Agriculture, but such highways shall remain under the control and jurisdiction of such agencies.

The Secretary of Agriculture is authorized to cooperate with the State highway departments, and with the Department of the Interior in the construction of public highways within Indian reservations, and to pay the amount assumed therefor from the funds allotted or apportioned under this Act to the State wherein the reservation is located.

SEC. 4. That the Secretary of Agriculture shall establish an accounting division which shall devise and install a proper method of keeping the accounts.

SEC. 5. That the Secretary of War be, and he is hereby, authorized and directed to transfer to the Secretary of Agriculture, upon his request, all war material, equipment, and supplies now or hereafter declared surplus from stock now on hand and not needed for the purposes of the War Department but suitable for use in the improvement of highways, and that the same shall be distributed among the highway departments of the several States to be used in the construction, reconstruction, and maintenance of highways, such distribution to be upon the same basis as that hereinafter provided for in this Act in the distribution of Federal-aid fund: *Provided*, That the Secretary of Agriculture, in his discretion, may reserve from such distribution not to exceed 10 per centum of such material, equipment, and supplies for use in the construction, reconstruction, and maintenance of national forest roads or other roads constructed, reconstructed, or maintained under his direct supervision.

SEC. 6. That in approving projects to receive Federal aid under the provisions of this Act the Secretary of Agriculture shall give preference to such projects as will expedite the completion



of an adequate and connected system of highways, interstate in character.

Before any projects are approved in any State, such State, through its State highway department, shall select or designate a system of highways not to exceed 7 per centum of the total highway mileage of such State as shown by the records of the State highway department at the time of the passage of this Act.

Upon this system all Federal-aid apportionments shall be expended.

Highways which may receive Federal aid shall be divided into two classes, one of which shall be known as primary or interstate highways, and shall not exceed three-sevenths of the total mileage which may receive Federal aid, and the other which shall connect or correlate therewith and be known as secondary or inter-county highways, and shall consist of the remainder of the mileage which may receive Federal aid.

The Secretary of Agriculture shall have authority to approve in whole or in part the systems as designated or to require modifications or revisions thereof: *Provided*, That the States shall submit to the Secretary of Agriculture for his approval any proposed revisions of the designated systems of highways above provided for.

Not more than 60 per centum of all Federal aid allotted to any State shall be expended upon the primary or interstate highways until provision has been made for the improvement of the entire system of such highways: *Provided*, That with the approval of any State highway department the Secretary of Agriculture may approve the expenditure of more than 60 per centum of the Federal aid apportioned to such State upon the primary or interstate highways in such State.

The Secretary of Agriculture may approve projects submitted by the State highway departments prior to the selection, designation, and approval of the system of Federal-aid highways herein provided for if he may reasonably anticipate that such projects will become a part of such system.

Whenever provision has been made by any State for the completion and maintenance of a system of primary or interstate and secondary or intercounty highways equal to 7 per centum of the total mileage of such State, as required by this Act, said State, through its State highway department, by and with the approval of the Secretary of Agriculture, is hereby authorized to add to the mileage of primary or interstate and secondary or intercounty systems as funds become available for the construction and maintenance of such additional mileage.

SEC. 7. That before any project shall be approved by the Secretary of Agriculture for any State such State shall make provisions for State funds required each year of such States by this Act for

construction, reconstruction, and maintenance of all Federal-aid highways within the State, which funds shall be under the direct control of the State highway department.

SEC. 8. That only such durable types of surface and kinds of materials shall be adopted for the construction and reconstruction of any highway which is a part of the primary or interstate and secondary or intercounty systems as will adequately meet the existing and probable future traffic needs and conditions thereon. The Secretary of Agriculture shall approve the types and width of construction and reconstruction and the character of improvement, repair, and maintenance in each case, consideration being given to the type and character which shall be best suited for each locality and to the probable character and extent of the future traffic.

SEC. 9. That all highways constructed or reconstructed under the provisions of this Act shall be free from tolls of all kinds.

That all highways in the primary or interstate system constructed after the passage of this Act shall have a right of way of ample width and a wearing surface of an adequate width which shall not be less than eighteen feet, unless, in the opinion of the Secretary of Agriculture, it is rendered impracticable by physical conditions, excessive costs, probable traffic requirements, or legal obstacles.

SEC. 10. That when any State shall have met the requirements of this Act, the Secretary of the Treasury, upon receipt of certification from the governor of such State to such effect, approved by the Secretary of Agriculture, shall immediately make available to such State, for the purpose set forth in this Act, the sum apportioned to such State as herein provided.

SEC. 11. That any State having complied with the provisions of this Act, and desiring to avail itself of the benefits thereof, shall by its State highway department submit to the Secretary of Agriculture project statements setting forth proposed construction or reconstruction of any primary or interstate, or secondary or intercounty highway therein. If the Secretary of Agriculture approve the project, the State highway department shall furnish to him such surveys, plans, specifications, and estimates therefor as he may require; items included for engineering, inspection, and unforeseen contingencies shall not exceed 10 per centum of the total estimated cost of its construction.

That when the Secretary of Agriculture approves such surveys, plans, specifications, and estimates, he shall notify the State highway department and immediately certify the fact to the Secretary of the Treasury. The Secretary of the Treasury shall thereupon set aside the share of the United States payable under this Act on account of such projects, which shall not exceed 50 per centum of the total estimated cost thereof, except that in the case of any



State containing unappropriated public lands exceeding 5 per centum of the total area of all lands in the State, the share of the United States payable under this Act on account of such projects shall not exceed 50 per centum of the total estimated cost thereof plus a percentage of such estimated cost equal to one-half of the percentage which the area of the unappropriated public lands in such State bears to the total area of such State: *Provided*, That the limitation of payments not to exceed \$20,000 per mile, under existing law, which the Secretary of Agriculture may make be, and the same is hereby, increased in proportion to the increased percentage of Federal aid authorized by this section: *Provided further*, That these provisions relative to the public-land States shall apply to all unobligated or unmatched funds appropriated by the Federal Aid Act and payment for approved projects upon which actual building construction work had not begun on the 30th day of June, 1921.

SEC. 12. That the construction and reconstruction of the highways or parts of highways under the provisions of this Act, and all contracts, plans, specifications, and estimates relating thereto, shall be undertaken by the State highway departments subject to the approval of the Secretary of Agriculture. The construction and reconstruction work and labor in each State shall be done in accordance with its laws and under the direct supervision of the State highway department, subject to the inspection and approval of the Secretary of Agriculture and in accordance with the rules and regulations pursuant to this Act.

SEC. 13. That when the Secretary of Agriculture shall find that any project approved by him has been constructed or reconstructed in compliance with said plans and specifications, he shall cause to be paid to the proper authorities of said State the amount set aside for said project.

That the Secretary of Agriculture may, in his discretion, from time to time, make payments on such construction or reconstruction as the work progresses, but these payments, including previous payments, if any, shall not be more than the United States pro rata part of the value of the labor and materials which have been actually put into such construction or reconstruction in conformity to said plans and specifications. The Secretary of Agriculture and the State highway department of each State may jointly determine at what time and in what amounts payments as work progresses shall be made under this Act.

Such payments shall be made by the Secretary of the Treasury, on warrants drawn by the Secretary of Agriculture, to such official or officials or depository as may be designated by the State highway department and authorized under the laws of the State to receive public funds of the State.

SEC. 14. That should any State fail to maintain any highway within its boundaries after construction or reconstruction under the provisions of this Act, the Secretary of Agriculture shall then serve notice upon the State highway department of that fact, and if within ninety days after receipt of such notice said highway has not been placed in proper condition of maintenance, the Secretary of Agriculture shall proceed immediately to have such highway placed in a proper condition of maintenance and charge the cost thereof against the Federal funds allotted to such State, and shall refuse to approve any other project in such State, except as hereinafter provided.

Upon the reimbursement by the State of the amount expended by the Federal Government for such maintenance, said amount shall be paid into the Federal highway fund for reapportionment among all States for the construction of roads under this Act, and the Secretary of Agriculture shall then approve further projects submitted by the State as in this Act provided.

Whenever it shall become necessary for the Secretary of Agriculture under the provisions of this Act to place any highway in a proper condition of maintenance the Secretary of Agriculture shall contract with some responsible party or parties for doing such work: *Provided, however,* That in case he is not able to secure a satisfactory contract he may purchase, lease, hire, or otherwise obtain all necessary supplies, equipment, and labor, and may operate and maintain such motor and other equipment and facilities as in his judgment are necessary for the proper and efficient performance of his functions.

SEC. 15. That within two years after this Act takes effect the Secretary of Agriculture shall prepare, publish, and distribute a map showing the highways and forest roads that have been selected and approved as a part of the primary or interstate, and the secondary or intercounty systems, and at least annually thereafter shall publish supplementary maps showing his program and the progress made in selection, construction, and reconstruction.

SEC. 16. That for the purpose of this Act the consent of the United States is hereby given to any railroad or canal company to convey to the highway department of any State any part of its right of way or other property in that State acquired by grant from the United States.

SEC. 17. That if the Secretary of Agriculture determines that any part of the public lands or reservations of the United States is reasonably necessary for the right of way of any highway or forest road or as a source of materials for the construction or maintenance of any such highway or forest road adjacent to such lands or reservations, the Secretary of Agriculture shall file with the Secretary of the department supervising the administration of such land or reservation a map showing the portion of such lands or reservations which it is desired to appropriate.



If within a period of four months after such filing the said Secretary shall not have certified to the Secretary of Agriculture that the proposed appropriation of such land or material is contrary to the public interest or inconsistent with the purposes for which such land or materials have been reserved, or shall have agreed to the appropriation and transfer under conditions which he deems necessary for the adequate protection and utilization of the reserve, then such land and materials may be appropriated and transferred to the State highway department for such purposes and subject to the conditions so specified.

If at any time the need for any such lands or materials for such purposes shall no longer exist, notice of that fact shall be given by the State highway department to the Secretary of Agriculture, and such lands or materials shall immediately revert to the control of the Secretary of the department from which they had been appropriated.

SEC. 18. That the Secretary of Agriculture shall prescribe and promulgate all needful rules and regulations for the carrying out of the provisions of this Act, including such recommendations to the Congress and the State highway departments as he may deem necessary for preserving and protecting the highways and insuring the safety of traffic thereon.

SEC. 19. That on or before the first Monday in December of each year the Secretary of Agriculture shall make a report to Congress, which shall include a detailed statement of the work done, the status of each project undertaken, the allocation of appropriations, an itemized statement of the expenditures and receipts during the preceding fiscal year under this Act, an itemized statement of the traveling and other expenses, including a list of employees, their duties, salaries, and traveling expenses, if any, and his recommendations, if any, for new legislation amending or supplementing this Act. The Secretary of Agriculture shall also make such special reports as Congress may request.

SEC. 20. That for the purpose of carrying out the provisions of this Act there is hereby appropriated, out of the moneys in the Treasury not otherwise appropriated, \$75,000,000 for the fiscal year ending June 30, 1922, \$25,000,000 of which shall become immediately available, and \$50,000,000 of which shall become available January 1, 1922.

SEC. 21. That so much, not to exceed 2½ per centum, of all moneys hereby or hereafter appropriated for expenditure under the provisions of this Act, as the Secretary of Agriculture may deem necessary for administering the provisions of this Act and for carrying on necessary highway research and investigational studies independently or in cooperation with the State highway departments and other research agencies, and for publishing the

results thereof, shall be deducted for such purposes, available until expended.

Within sixty days after the close of each fiscal year the Secretary of Agriculture shall determine what part, if any, of the sums therefore deducted for such purposes will not be needed and apportion such part, if any, for the fiscal year then current in the same manner and on the same basis as are other amounts authorized by this Act apportioned among all the States, and shall certify such apportionment to the Secretary of the Treasury and to the State highway departments.

The Secretary of Agriculture, after making the deduction authorized by this section, shall apportion the remainder of the appropriation made for expenditure under the provision of the Act for the fiscal year among the several States in the following manner: One-third in the ratio which the area of each State bears to the total area of all the States; one-third in the ratio which the population of each State bears to the total population of all the States, as shown by the latest available Federal census; one-third in the ratio which the mileage of rural delivery routes and star routes in each State bears to the total mileage of rural delivery and star routes in all the States at the close of the next preceding fiscal year, as shown by certificate of the Postmaster General, which he is directed to make and furnish annually to the Secretary of Agriculture: *Provided*, That no State shall receive less than one-half of 1 per centum of each year's allotment. All moneys herein or hereafter appropriated for expenditure under the provisions of this Act shall be available until the close of the second succeeding fiscal year for which apportionment was made: *Provided further*, That any sums apportioned to any State under the provisions of the Act entitled "An Act to provide that the United States shall aid the States in the construction of rural post roads, and for other purposes," approved July 11, 1916, and all Acts amendatory thereof and supplemental thereto, shall be available for expenditure in that State for the purpose set forth in such Acts until two years after the close of the respective fiscal years for which any such sums become available, and any amount so apportioned remaining unexpended at the end of the period during which it is available for expenditure under the terms of such Acts shall be reapportioned according to the provisions of the Act entitled "An Act to provide that the United States shall aid the States in the construction of rural post roads, and for other purposes," approved July 11, 1916: *And provided further*, That any amount apportioned under the provisions of this Act unexpended at the end of the period during which it is available for expenditure under the terms of this section shall be reapportioned within sixty days thereafter to all the States in the same manner and on the same basis, and certified to the Secretary of



the Treasury and the State highway departments in the same way as if it were being apportioned under this Act for the first time.

SEC. 22. That within sixty days after the approval of this Act the Secretary of Agriculture shall certify to the Secretary of the Treasury and to each of the State highway departments the sum he has estimated to be deducted for administering the provisions of this Act and the sums which he has apportioned to each State for the fiscal year ending June 30, 1922, and on or before January 20 next preceding the commencement of each succeeding fiscal year, and shall make like certificates for each fiscal year.

SEC. 23. That out of the moneys in the Treasury not otherwise appropriated, there is hereby appropriated for the survey, construction, reconstruction, and maintenance of forest roads and trails, the sum of \$5,000,000 for the fiscal year ending June 30, 1922, available immediately and until expended, and \$10,000,000 for the fiscal year ending June 30, 1923, available until expended.

(a) Fifty per centum, but not to exceed \$3,000,000 for any one fiscal year, of the appropriation made or that may hereafter be made for expenditure under the provisions of this section shall be expended under the direct supervision of the Secretary of Agriculture in the survey, construction, reconstruction, and maintenance of roads and trails of primary importance for the protection, administration, and utilization of the national forests, or when necessary, for the use and development of the resources upon which communities within or adjacent to the national forests are dependent, and shall be apportioned among the several States, Alaska, and Porto Rico by the Secretary of Agriculture, according to the relative needs of the various national forests, taking into consideration the existing transportation facilities, value of timber, or other resources served, relative fire danger, and comparative difficulties of road and trail construction.

The balance of such appropriations shall be expended by the Secretary of Agriculture in the survey, construction, reconstruction, and maintenance of forest roads of primary importance to the State, counties, or communities within, adjoining, or adjacent to the national forests, and shall be prorated and apportioned by the Secretary of Agriculture for expenditures in the several States, Alaska, and Porto Rico, according to the area and value of the land owned by the Government within the national forests therein as determined by the Secretary of Agriculture from such information, investigation, sources, and departments as the Secretary of Agriculture may deem most accurate.

(b) Cooperation of Territories, States, and civil subdivisions thereof may be accepted but shall not be required by the Secretary of Agriculture.

(c) The Secretary of Agriculture may enter into contracts with any Territory, State, or civil subdivision thereof for the construction, reconstruction, or maintenance of any forest road or trail or part thereof.

(d) Construction work on forest roads or trails estimated to cost \$5,000 or more per mile, exclusive of bridges, shall be advertised and let to contract.

If such estimated cost is less than \$5,000 per mile, or if, after proper advertising, no acceptable bid is received, or the bids are deemed excessive, the work may be done by the Secretary of Agriculture on his own account; and for such purpose the Secretary of Agriculture may purchase, lease, hire, rent, or otherwise obtain all necessary supplies, materials, tools, equipment, and facilities required to perform the work.

The appropriation made in this section of that may hereafter be made for expenditure under the provisions of this section may be expended for the purpose herein authorized and for the payment of wages, salaries, and other expenses for help employed in connection with such work.

SEC. 24. That in any State where the existing constitution or laws will not permit the State to provide revenues for the construction, reconstruction, or maintenance of highways, the Secretary of Agriculture shall continue to approve projects for said State until three years after the passage of this Act, if he shall find that said State has complied with the provisions of this Act in so far as its existing constitution and laws will permit.

SEC. 25. That if any provision of this Act, or the application thereof to any person or circumstances, shall be held invalid, the validity of the remainder of the Act and of the application of such provision to other persons or circumstances shall not be affected thereby.

SEC. 26. That all Acts or parts of Acts in any way inconsistent with the provisions of this Act are hereby repealed, and this Act shall take effect on its passage.

Approved, November 9, 1921.



## FEDERAL-AID ROAD WORK

By UNITED STATES BUREAU OF PUBLIC ROADS

CONSIDERING the amount of money involved and the size of the force employed, the research work of the bureau is dwarfed by the magnitude of the Federal-aid and forest road work which it administers. Together these works constitute the greatest program of road construction ever undertaken under single control in the history of the world.

The law under which this great work was inaugurated in 1916 is known as the Federal Aid Road Act. The original act was amended in 1919, and in November of last year the Federal Highway Act amended it again. By the original act, its 1919 amendment and the recent road act a total of \$350,000,000 has been appropriated for Federal-aid roads and \$34,000,000 for forest roads. As the name of the original act implies the roads constructed under it are not built by the Federal government alone, but by the States and the government in coöperation. The framers of the law recognized the success which had crowned the efforts of the States that had State highway departments to supervise the construction of their roads, and one of the principal provisions of the law was designed to encourage the formation of adequate highway departments in all of the States. The actual supervision of the construction of the Federal-aid roads was placed upon the highway departments of the States, and no State could receive aid under the law unless it had a State highway department adequate in the opinion of the Secretary of Agriculture to perform the functions expected of it.

### Organization and Procedure

Although the direct supervision of the construction work is done by the State highway departments the responsibility for final approval is put upon the bureau, and this duty in itself requires a large force of engineers.

Instead of centralizing all authority in Washington, the United States has been divided into 13 districts, and a district engineer has been placed in charge of each, who is authorized to deal directly with the State departments included in his district. Where the work is sufficiently heavy to warrant it, one or more resident engineers have been placed in a State. In other districts men are assigned by the district engineers to cover special States, but do not have headquarters in the State.

By thus decentralizing the organization much closer relations can be maintained with the State departments than would be possible through a single remote organization located in Washington. As the district engineers are authorized to approve plans submitted by the States a great deal of time is saved which would otherwise be lost in sending plans and documents back and forth to Washington.

The central organization at Washington is comparatively small, consisting only of the chief of bureau and chief engineer and a staff of reviewing engineers maintained to coördinate the work of the various districts and to act as a check upon the district offices.

In order to still further reduce the time lost by the necessity for a review of the work of the district offices a regional office in charge of a deputy chief engineer has been established at San Francisco. The deputy chief engineer has authority over the six western districts.

As the first step in the improvement of a road, the State prepares a statement and forwards it to the district engineer in authority, announcing that it proposes to build a piece of road of a certain type and length in a certain location. The district engineer examines the location of the proposed road with the purpose of determining whether the kind of construction proposed by the State complies with the Federal requirements; and if, in his opinion, it does, he forwards the statement to the Washington office or the regional office with his recommendation. If the chief engineer concurs in the recommendation of the district engineer, the project is placed before the Secretary of Agriculture by the chief of bureau, with the recommendation of the bureau for approval.

Until the Secretary has signified that the United States will co-operate, no further action is taken by the State. If the Secretary approves, the State is so notified, and it then proceeds to prepare detailed plans, specifications and estimates for the work.

After the plans and specifications have been prepared by the State, they are submitted to the district engineer, together with an estimate of the cost based upon the carefully computed quantities of the work to be done. The district engineer or one of his representatives makes an inspection of the proposed work on the ground, and upon this inspection the district engineer bases his approval or disapproval of the plans. Generally the Federal engineer does not wait until the plans are completed, but goes over the road to be built with one of the State engineers while the plans are being prepared. He is often able, in this way, to suggest changes in the plans which facilitate their approval upon completion.

As soon as the plans are recommended for approval by the district engineer, the State may advertise for bids and let the contract. There may be minor adjustments and changes to be made before the plans are approved by the Secretary, but the State is



not required to wait for these matters to be cleared up before it starts construction work on the project.

After approval of the plans by the Secretary the coöperation of the government is assured. The signing of the formal coöperative agreement follows in due course, but it is not necessary that the work be delayed pending this formality.

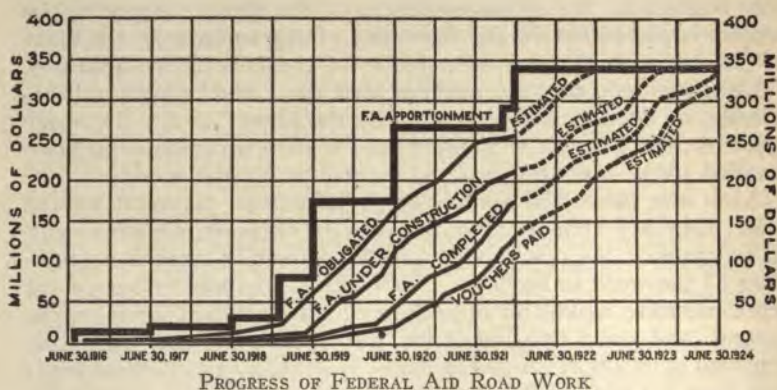
### Progress of the Work

Up to November 30, 1921, projects involving a total of 35,358 miles of road had been approved by the Secretary of Agriculture, and Federal aid in the amount of \$255,631,066 had been set aside for them. On the same date 11,753 miles of road had been entirely completed, and 16,766 additional miles were in various stages of construction. The projects that were under construction were reported as being 68 per cent completed.

Including the aid allotted to the projects entirely completed and that allotted to the completed portions of projects under construction, the work which had been done up to November 30, 1921, involved \$169,462,696 of Federal-aid money.

### Character of Federal-Aid Roads

In the approval of Federal-aid projects every modern type of rural road has been recognized as having relative merit. In so



large a program of construction distributed throughout a territory like that of the United States no other attitude could be assumed. Not only the technical requirements but the logic of highway economics insisted upon such an attitude. Roads have been constructed over mountain, plain, and desert, on the alluvial soils of the Mississippi Delta, the sand deposits of the Coastal Plain, and

## STATUS OF FEDERAL AID PROJECTS, NOVEMBER 30, 1921.

States	Projects on which Construction is Completed		
	Total Estimated Cost	Federal Aid	Miles
Alabama.....	\$2,984,373	\$1,404,382	309.3
Arizona.....	3,292,235	1,600,065	175.9
Arkansas.....	2,664,016	1,105,880	271.2
California.....	5,294,079	2,550,189	263.2
Colorado.....	3,112,251	1,487,971	192.1
Connecticut.....	439,722	210,030	16.5
Delaware.....	1,615,761	393,655	28.1
Florida.....	482,729	230,602	33.9
Georgia.....	10,617,633	4,797,842	581.0
Idaho.....	5,826,964	2,740,123	372.4
Illinois.....	22,066,641	10,193,031	672.6
Indiana.....	2,062,707	1,008,197	52.0
Iowa.....	4,147,500	1,567,388	276.9
Kansas.....	2,753,934	982,756	90.3
Kentucky.....	2,359,682	1,137,942	114.5
Louisiana.....	2,573,652	1,170,752	237.9
Maine.....	1,413,390	676,732	54.6
Maryland.....	3,685,231	1,753,840	135.5
Massachusetts.....	3,501,338	1,549,588	106.1
Michigan.....	3,621,290	1,733,976	168.5
Minnesota.....	9,538,824	3,745,200	1,034.9
Mississippi.....	1,317,051	631,381	165.9
Missouri.....	802,472	324,771	76.9
Montana.....	2,703,538	1,310,695	227.3
Nebraska.....	3,514,929	1,675,237	662.8
Nevada.....	1,754,660	838,225	113.2
New Hampshire.....	1,861,922	897,232	115.4
New Jersey.....	3,088,695	1,214,617	73.4
New Mexico.....	1,756,787	876,569	191.7
New York.....	1,087,396	491,853	30.7
North Carolina.....	5,718,046	2,573,462	419.2
North Dakota.....	1,363,244	649,170	334.9
Ohio.....	11,462,505	3,751,480	349.7
Oklahoma.....	1,396,112	669,143	51.5
Oregon.....	5,485,361	2,626,592	338.3
Pennsylvania.....	19,497,438	7,648,490	397.6

## STATUS OF FEDERAL AID PROJECTS, NOVEMBER 30, 1921—Continued.

States	Projects on which Construction is Completed		
	Total Estimated Cost	Federal Aid	Miles
Rhode Island . . . . .	1,068,765	450,080	27.0
South Carolina . . . . .	3,100,549	1,436,893	303.4
South Dakota . . . . .	1,451,568	721,532	148.6
Tennessee . . . . .	38,606	19,303	0.02*
Texas . . . . .	10,929,870	4,516,067	110.3
Utah . . . . .	399,096	198,529	17.7
Vermont . . . . .	325,310	159,103	14.6
Virginia . . . . .	3,136,006	1,542,737	207.2
Washington . . . . .	7,202,006	3,354,892	321.4
West Virginia . . . . .	1,216,111	550,906	52.9
Wisconsin . . . . .	6,676,222	2,363,307	495.1
Wyoming . . . . .	2,469,104	1,158,919	318.7
TOTALS . . . . .	\$194,877,321	\$84,691,326	11,752.8

\* Bridge.

the fertile soils of the Ohio and Mohawk Valleys, in such States as New Mexico and Arizona, where the local and through traffic is light, as well as in the populous States of the Atlantic seaboard, where the traffic is exceptionally heavy. Obviously, the standards of approval could not be the same under such a variety of conditions, and the purpose of the bureau has been in all cases to be guided by the best engineering judgment in determining the type or types of construction adequate for each particular project. For both financial and technical reasons, the bureau has recognized two phases of construction, the first including the building of an adequate grade with all necessary drainage structures and with grades and curvature satisfactory for any anticipated future use of the highway; these being the most permanent features of a highway. The second phase involves the placing of adequate surfacing when traffic demands warrant the additional cost. Where only a graded road is constructed the agreement entered into by the State highway department and the Secretary of Agriculture pledges the good faith of the State to construct an adequate surface when the development of traffic and the increasing cost of maintenance indicate the need.



## STATUS OF FEDERAL AID PROJECTS, NOVEMBER 30, 1921.

States	Projects Under Construction			
	Total Estimated Cost	Federal Aid	Miles	Per Cent Complete
Alabama.....	\$2,146,169	\$1,555,360	237.8	35
Arizona.....	3,180,005	1,396,626	153.4	78
Arkansas.....	9,261,820	3,075,374	721.7	61
California.....	7,530,312	3,744,848	340.3	49
Colorado.....	3,750,792	1,852,270	241.8	65
Connecticut.....	2,461,879	932,075	48.2	63
Delaware.....	210,143	54,000	6.0	95
Florida.....	5,403,033	2,602,577	157.5	68
Georgia.....	5,584,464	2,509,736	545.3	66
Idaho.....	920,180	449,369	51.4	95
Illinois.....	3,435,918	1,417,745	80.5	95
Indiana.....	5,407,503	2,631,406	143.9	53
Iowa.....	14,596,784	5,986,424	1,144.1	83
Kansas.....	19,011,827	5,346,677	510.8	66
Kentucky.....	6,496,059	3,158,315	262.1	70
Louisiana.....	5,511,815	2,471,587	431.5	82
Maine.....	3,971,516	1,946,287	107.4	65
Maryland.....	1,254,848	577,016	35.6	68
Massachusetts.....	2,620,315	1,022,364	48.3	85
Michigan.....	8,213,465	3,901,185	285.9	78
Minnesota.....	10,341,152	3,748,703	809.7	64
Mississippi.....	6,538,201	3,166,896	484.9	58
Missouri.....	10,429,936	4,730,234	556.3	66
Montana.....	5,360,403	2,645,819	494.9	77
Nebraska.....	5,613,865	2,790,768	917.7	94
Nevada.....	1,227,762	610,989	82.8	84
New Hampshire.....	410,988	202,117	23.3	64
New Jersey.....	2,189,093	579,882	28.9	56
New Mexico.....	3,386,065	1,693,032	563.8	55
New York.....	14,983,314	6,416,659	357.2	46
North Carolina.....	7,416,102	3,590,628	507.0	86
North Dakota.....	5,379,724	2,689,862	821.1	80
Ohio.....	13,059,713	4,245,191	318.7	89
Oklahoma.....	8,730,555	3,741,055	310.3	52
Oregon.....	3,558,151	1,662,562	132.9	90
Pennsylvania.....	13,742,984	4,528,309	224.5	90



## STATUS OF FEDERAL AID PROJECTS, NOVEMBER 30, 1921—Continued.

States	Projects Under Construction			
	Total Estimated Cost	Federal Aid	Miles	Per Cent Complete
Rhode Island.....	529,475	187,331	11.6	57
South Carolina.....	4,338,938	2,015,566	409.6	55
South Dakota.....	6,407,230	3,158,607	688.7	61
Tennessee.....	11,422,779	5,702,272	449.1	42
Texas.....	22,358,616	8,047,282	1,388.4	55
Utah.....	3,064,274	1,529,822	251.3	86
Vermont.....	1,030,755	514,883	38.4	86
Virginia.....	4,655,407	2,298,433	201.6	78
Washington.....	1,696,274	575,936	51.5	75
West Virginia.....	4,995,899	2,267,065	248.0	77
Wisconsin.....	8,221,424	3,231,120	543.03	75
Wyoming.....	3,554,712	1,690,132	296.8	69
TOTALS.....	\$296,612,638	\$124,892,396	16,765.8	68

CHARACTER OF FEDERAL AID PROJECTS COMPLETED AND UNDER AGREEMENT,  
NOVEMBER 1, 1921.

Character of Project	Estimated Total Cost		Federal Aid		Mileage	
	Amount	Per Cent of Total	Amount	Per Cent of Total	Amount	Per Cent of Total
Grading and Drainage...	\$56,704,254	11.2	\$24,721,021	11.7	6,864	24.4
Sand-clay.....	22,226,363	4.5	10,495,172	5.0	2,696	9.6
Gravel.....	104,614,067	21.2	47,192,895	22.4	10,043	35.7
Water-bound macadam...	22,452,779	4.5	9,729,201	4.6	1,291	4.6
Bituminous macadam...	41,412,557	8.3	18,646,066	8.8	1,323	4.7
Bituminous concrete...	23,445,375	4.7	9,299,864	4.4	773	2.7
Concrete.....	184,021,245	37.1	75,600,279	35.8	4,654	16.5
Brick.....	22,039,845	4.4	6,925,482	3.3	445	1.6
Bridges.....	20,235,200	4.1	8,525,394	4.0	47	0.2
Total all types.....	\$496,151,683	100.0	\$211,135,376	100.0	28,135	100.0

## National Forest Roads.

The importance of the national forest road project is becoming more clearly apparent with the development of construction. Many important State and interstate highways now under improvement with Federal aid traverse the national forests, and it is seen that the development of the State systems will be incomplete until the national forest links are built. In the construction of the forest

roads built up to the present time the purpose has been to develop service roads for the protection and administration of the forests, to build the more important sections of State roads in urgent need of construction, and to develop county roads in the forest areas which have been necessary for community use. There are approximately 14,000 miles of main State and county roads within the forests still to be constructed, and in addition there are estimated to be about 13,000 miles of service roads. Adequately to construct only the roadbed for the 14,000 miles of main State and county roads will require approximately \$150,000,000. Many of these roads must be surfaced at an additional cost.

The development of the 13,000 miles of service roads must proceed simultaneously for the protection and administration of the forests and will involve in excess of \$50,000,000, as near as may be estimated.

The Bureau of Public Roads has been called upon to make surveys and plans for and to construct the major roads in the forest road-building project. The Forest Service prepares the necessary agreements with local authorities, and these agreements become the authority of the Bureau of Public Roads for action under the amounts stipulated. Promptly after January 1, the Forest Service prepares a working program for the season's construction. This program is based upon the report of progress for the preceding year and involves the surveys of the preceding season. The construction season in many of the forests is very short. Owing to altitude, and in some cases to latitude, numerous projects can not be worked until July and must close in October. For this reason advertisements for bids are issued as early as may be in the spring in order that every day of the construction season may be fully utilized.

### Forest Road Progress

During the fiscal year 1921 the advance in forest road construction was greater than in any year since the beginning of the work.

Sixty-seven projects were completed or brought to approximate completion during the year, totaling 719 miles. Among them are several in each district that are worthy of special notice, such as the 28.5 miles of grading on the McKenzie highway across the Cascade Mountains in district 1, and 19.3 miles between Prineville and Mitchell through the Ochoco forest, both in Oregon, and the completion of section 1 of the Lake Crescent road, which is a part of the Washington State highway system. In district 2, which

includes California, notable progress has been made on the Klamath River Canyon road in the Klamath forest, and about 24 miles have been opened to travel. Colorado, in district 3, has seen the practical completion of the Monarch Pass road, 27.7 miles in length, and partial completion of the Independence Pass project. In Idaho the western section of the Lolo Pass highway leading from the Bitterroot Valley to Lewiston has been finished between Kooskia and Lowell for a distance of 22.8 miles. In Montana, district 11, there has been notable progress on the various sections of the West Gallatin project, totaling 13.4 miles. This project will eventually lead to Yellowstone Park. In district 12 the Warm River-Yellowstone project is nearly completed, leading from the Warm River in Idaho to Yellowstone in the National Park. The Ephraim-Orangeville road in Utah, about 22 miles in length, is practically completed; also 9 miles of the Heber-Fruitland project, in addition to about 27 miles previously constructed. In Wyoming the Hoback Canyon and Teton Pass roads are finished. In district 13 large projects have been finished in New Mexico, including the Cimarron-Taos, 18 miles; the Glorieta-Panchuela, 17 miles; and the Hondo-Mescalero, 26.4 miles. In Arizona there have been completed, or practically completed, three projects of note, the Snowflake-Pinetop, 37.6 miles, a section of the Salt River-Pleasant Valley project, the total length of which is 23.8 miles, and 11 miles of the Oracle-Apache, making the completed length of this project 15 miles.

### **Distribution of Surplus War Materials**

The total value of the surplus war materials, equipment and supplies distributed by the bureau to the State highway departments for use in road construction is approximately \$120,000,000. This does not include the material, valued at approximately \$12,000,000, retained by the Department of Agriculture.

The beneficial effects of the distribution of this material, the value of which exceeds the total money aid actually paid to the States, can scarcely be estimated. That distributed in 1919 and 1920 enabled many States to continue some semblance of a highway construction program throughout that difficult period; and in a majority of the States the equipment received from the Government made it possible to maintain roads which otherwise would have been allowed to deteriorate because of the lack of the necessary equipment or funds with which to purchase it.

The material distributed, in addition to motor vehicles and major construction machinery, is as various as the needs of road construction under the wide range of natural conditions existing



in the United States. No material has been distributed for which there is not an actual need in road building, and none has been shipped to any State except upon request of the State highway department.

In the distribution of so vast an accumulation, the shipment of a certain amount of unserviceable material is not to be avoided. Instances of this sort have been reported; and, almost invariably, the cause is found to be a faulty description of the equipment on existing inventories. That the number of such cases has been insignificant, however, is revealed by a thorough investigation, which shows that the value of the unserviceable material exchanged or sold as junk by the States has amounted to less than one-half of 1 per cent of the value of the surplus war materials distributed to all the State highway departments.

The motor trucks, in particular, have been most gratefully received by the several States. In most cases the vehicles, as received, have not been suitable for construction use, but they have been adapted by the installation of special bodies and hoisting or unloading devices at very moderate cost, and recent investigation reveals a general feeling of satisfaction with the results obtained. Most of the States have provided well-equipped shops and garages for the maintenance and protection of their equipment.

Of the miscellaneous material distributed, the large part consists of machinery, equipment, and tools commonly used in road construction. In a number of instances material especially designed for war purposes has been ingeniously adapted to other uses. For example, the bombproof shelters known as elephant shelters have been employed in the mountains of Colorado as snow shelters and in the deserts of Arizona as large culverts to protect the roads from floods resulting from the infrequent but heavy rains which visit those sections.

Nearly 20,000,000 pounds of TNT intended for military demolition purposes have been diverted to peaceful constructive uses, for which it has proved so suitable that it is preferred by many blasting experts to dynamite. Large quantities of hand grenade and other powders have also been utilized to excellent advantage.

Galvanized corrugated iron has been employed to build shops, garages, and offices, the windows of which, in at least one case, have been shaded by awnings ingeniously contrived from surplus canopy tops taken from motor trucks.

In one case which has been reported, pipe received from the Government was used to carry compressed air from the compressors to the drills used in the excavation of the foundations for a bridge, and the same pipe was afterward employed as the guard rail on the bridge.



The value of the motor vehicles, road-building equipment and miscellaneous supplies distributed up to December 1, 1921, is as follows:

<i>State</i>	<i>Value delivered to December 1</i>	<i>State</i>	<i>Value delivered to December 1</i>
Alabama.....	\$2,606,000.00	Nevada.....	\$1,182,000.00
Arizona.....	2,200,000.00	New Hampshire.....	420,000.00
Arkansas.....	2,130,000.00	New Jersey.....	1,700,000.00
California.....	3,750,000.00	New Mexico.....	2,200,000.00
Colorado.....	2,800,000.00	New York.....	5,600,000.00
Connecticut.....	653,000.00	North Carolina.....	3,100,000.00
Delaware.....	412,500.00	North Dakota.....	1,500,000.00
Florida.....	1,503,000.00	Ohio.....	4,300,000.00
Georgia.....	4,273,000.00	Oklahoma.....	2,200,000.00
Idaho.....	1,504,000.00	Oregon.....	1,700,000.00
Illinois.....	5,760,000.00	Pennsylvania.....	4,400,000.00
Indiana.....	3,100,000.00	Rhode Island.....	231,000.00
Iowa.....	2,900,000.00	South Carolina.....	1,800,000.00
Kansas.....	2,690,000.00	South Dakota.....	2,400,000.00
Kentucky.....	2,050,000.00	Tennessee.....	3,250,000.00
Louisiana.....	1,600,000.00	Texas.....	7,300,000.00
Maine.....	990,000.00	Utah.....	1,335,000.00
Maryland.....	1,100,000.00	Vermont.....	600,000.00
Massachusetts.....	909,000.00	Virginia.....	3,000,000.00
Michigan.....	4,648,000.00	Washington.....	1,500,000.00
Minnesota.....	3,290,000.00	West Virginia.....	2,250,000.00
Mississippi.....	3,300,000.00	Wisconsin.....	3,200,000.00
Missouri.....	3,860,000.00	Wyoming.....	1,250,000.00
Montana.....	2,400,000.00		
Nebraska.....	3,350,000.00	Total.....	\$120,196,500.00

### The Federal Highway Act

The Federal Highway Act, approved by President Harding November 9, 1921, appropriates \$75,000,000 as Federal aid for road construction in the various States, and \$15,000,000 for the construction of roads and trails in and adjacent to the national forests. Of the forest road appropriation \$5,000,000 became available immediately and \$10,000,000 will become available July 1, 1922.

Under the terms of the act the Federal-aid money will be available to the States for two years after the close of the fiscal year for which the money is appropriated. This provision is made to apply to the money appropriated under the previous act and its amendment, as well as to the new appropriation. The forest road appropriation is available until expended.

### Method of Distribution Slightly Changed

Not more than 2½ per cent of the appropriation for Federal aid may be deducted by the Secretary of Agriculture for the purpose of administering the provisions of the act and for highway research.

The balance of the appropriation is to be apportioned among the States in a manner similar to that which was prescribed by the

Federal Aid Act of 1916. The three factors governing the distribution remain as before—area, population, and mileage of rural delivery and star routes.

A new provision is that no State shall receive less than one-half of one per cent of the year's allotment. This stipulation will increase the amounts which would otherwise be received by four of the smaller States—Delaware, New Hampshire, Rhode Island and Vermont.

### The Apportionment to the States

After deducting the administrative allowance the amount available for apportionment is \$73,125,000. The apportionment of this sum to the several States and the amounts apportioned under previous acts are shown in the table on page 18.

### United States' Share Limited to 50 Per Cent Except in Public Land States

The participation of the United States in any one road project is limited to 50 per cent of the total estimated cost except in those States containing unappropriated public lands in excess of 5 per cent of all lands in the State. For these States the special provision is made that the Government may participate to the extent of 50 per cent plus a percentage of the total estimated cost equal to one-half of the percentage which the area of the public lands bears to the total area of the State. As a general rule the Government's participation is limited to \$20,000 per mile, but for the public-land States this amount may be increased in proportion to the increased percentage of Federal aid authorized. The provisions with respect to these States are made to apply to all unobligated funds appropriated by the previous acts and also to payments for approved projects upon which actual construction had not begun June 30, last. The States which benefit from these provisions are given in the table below, together with the maximum limit of Government participation allowed by the act.

<i>State</i>	<i>Proportion of Cost of Projects to be Paid by Government</i>	<i>State</i>	<i>Proportion of Cost of Projects to be Paid by Government</i>
Arizona.....	61.11	Nevada.....	87.23
California.....	57.37	New Mexico.....	61.51
Colorado.....	56.13	Oregon.....	61.14
Idaho.....	58.02	Utah.....	74.85
Montana.....	53.04	Wyoming.....	64.65



## FEDERAL AID APPORTIONMENTS

States	Apportionment Under New Act	Apportionment Under Old Acts	Total Apportion- ments Under New and Old Acts
Alabama.....	\$1,553,420.67	\$5,776,552.58	\$7,329,973.25
Arizona.....	1,053,281.44	3,771,351.69	4,824,633.13
Arkansas.....	1,254,142.20	4,619,929.47	5,874,071.67
California.....	2,462,098.53	8,384,354.57	10,846,453.10
Colorado.....	1,341,175.69	4,780,064.14	6,121,239.83
Connecticut.....	480,897.78	1,689,324.70	2,170,222.48
Delaware.....	365,625.00	447,654.83	813,279.83
Florida.....	886,825.69	3,150,112.48	4,036,938.17
Georgia.....	1,997,957.58	7,407,578.62	9,405,536.20
Idaho.....	938,536.68	3,360,388.86	4,298,925.54
Illinois.....	3,246,281.07	12,024,266.97	15,270,548.04
Indiana.....	1,958,855.41	7,415,292.61	9,374,148.02
Iowa.....	2,102,872.74	7,939,343.14	10,042,215.88
Kansas.....	2,102,281.51	7,895,309.07	9,997,590.58
Kentucky.....	1,417,178.68	5,370,064.79	6,787,243.47
Louisiana.....	996,989.64	3,742,524.57	4,739,514.21
Maine.....	695,160.25	2,645,963.57	3,341,123.82
Maryland.....	640,629.01	2,390,749.07	3,031,378.08
Massachusetts.....	1,096,176.04	4,052,565.09	5,148,741.13
Michigan.....	2,249,532.43	7,961,295.55	10,210,827.98
Minnesota.....	2,123,597.07	7,815,383.02	9,938,980.09
Mississippi.....	1,294,906.22	4,951,542.29	6,246,448.51
Missouri.....	2,448,128.62	9,322,075.71	11,770,204.33
Montana.....	1,546,885.82	5,498,827.31	7,045,713.13
Nebraska.....	1,581,189.50	5,866,761.66	7,447,951.16
Nevada.....	953,436.78	3,527,276.18	4,480,712.96
New Hampshire.....	365,625.00	1,143,088.99	1,508,713.99
New Jersey.....	942,870.95	3,265,299.02	4,208,169.97
New Mexico.....	1,189,823.34	4,389,794.61	5,579,617.95
New York.....	3,696,447.97	13,688,801.67	17,385,249.64
North Carolina.....	1,709,333.90	6,270,690.68	7,980,024.59
North Dakota.....	1,164,714.42	4,222,487.70	5,387,202.12
Ohio.....	2,823,004.05	10,202,947.71	13,025,951.76
Oklahoma.....	1,752,339.44	6,338,245.60	8,090,585.04
Oregon.....	1,182,663.90	4,332,178.26	5,514,842.16
Pennsylvania.....	3,398,953.97	12,632,644.29	16,031,598.26
Rhode Island.....	365,625.00	641,166.13	1,006,791.13
South Carolina.....	1,061,237.34	3,946,617.50	5,007,854.84
South Dakota.....	1,204,060.31	4,452,883.04	5,656,943.35



## FEDERAL AID APPORTIONMENTS.

States	Apportionment Under New Act	Apportionment Under Old Acts	Total Apportion- ments Under New and Old Acts
Tennessee.....	1,647,692.24	6,228,137.98	7,875,830.22
Texas.....	4,425,172.41	16,100,404.77	20,525,577.18
Utah.....	849,417.21	3,117,206.38	3,966,623.59
Vermont.....	365,625.00	1,242,103.73	1,607,728.73
Virginia.....	1,456,828.47	5,451,730.28	6,908,558.75
Washington.....	1,103,709.77	3,971,675.83	5,075,385.60
West Virginia.....	802,359.77	2,922,504.45	3,724,864.22
Wisconsin.....	1,894,815.86	7,004,280.67	8,899,096.53
Wyoming.....	934,617.63	3,378,558.17	4,313,175.80
TOTALS.....	\$73,125,000.00	\$266,750,000.00	\$339,875,000.00

### Federal Funds Must be Matched by Funds Under State Control

The funds to match the Government's contribution may be raised by the States or by any political or other subdivision of the States, but if the funds of a county or other local subdivision are to be used the new act requires that they shall be placed under the direct control of the State highway department. No project is to be approved in any State until the State has made provision for the money required both to match its share of the Federal appropriation and to maintain the roads built with the joint funds.

### Money to be Spent on a Connected System

The new appropriation is to be expended upon a definite connected system of highways in each State limited in extent to 7 per cent of the total mileage of highways in the State. This system is to be divided into two parts; the first, to include the more important roads which are to be known as the primary or interstate highways, is to contain not more than three-sevenths of the mileage in the system. The second part will include the secondary or inter-county highways which will make up the balance of the system.

These systems are to be designated by the State highway departments, but the Secretary of Agriculture is given authority to require modifications or revisions of the systems as selected. Until the States have had an opportunity to select their systems the Secretary will continue to approve new projects submitted if there is ground for reasonable anticipation that the projects submitted will become a part of the system when it is selected.

When a State has made provision for the completion and maintenance of a system equal to 7 per cent of its total highway mileage, the act provides that an addition may be made to the mileage of the primary and secondary systems, which will finally give such State a system which will include more than 7 per cent of its total road mileage.

The act contemplates that the primary or interstate system and the secondary or intercounty system shall be built up concurrently. One of its sections provides that not more than 60 per cent of the Federal aid allotted to a State may be expended upon the interstate system, except with the joint approval of the State highway department and the Secretary of Agriculture.

### **Type and Width Requirements**

New phraseology is introduced into the bill in the section which defines the requisite character of the Federal-aid roads. Instead of the term "substantial" used in the first act, the new act requires explicitly that only such durable types of surface and kinds of materials shall be adopted as will meet the existing and probable future traffic needs and conditions, consideration being given to peculiar local conditions.

This provision will not alter the policy heretofore followed by the Department of Agriculture. Its effect is to strengthen the position wisely taken by the Secretary several years ago in the construction which he placed upon the word "substantial" in the previous act.

An entirely new provision, however, is contained in the requirement as to width. After stating in general terms that the highways to be constructed hereafter must have right of way and surface of adequate width, the act lays down the definition of adequacy for the surface by requiring that it shall not be less than 18 feet wide.

### **Heavy Penalty for Failure to Maintain**

In line with the spirit of President Harding's first message to Congress, in which he deprecated the failure to give proper attention to the roads after their construction is completed so as to keep them constantly in condition to render service, the new act lays a heavy penalty upon failure to maintain the roads which are constructed under it. It defines maintenance in its broadest sense as the constant making of needed repairs to preserve a smooth-surfaced highway. To insure that each highway aided by the Government will receive that kind of maintenance, it provides that the Secretary of Agriculture shall serve notice upon any State which allows a road to suffer for lack of maintenance. If within 90 days

after the notice is served the proper attention has not been given to the road, the Secretary is authorized to maintain it and to charge the cost thereof against the Federal funds allotted to that State. What is more, he is directed to refuse to approve any other project in the State until the amount spent for maintenance of the project in question has been reimbursed by the State. When the money is paid back, it is not to be returned to the State's allotment of the appropriation, but is to be reapportioned among all the States, so that the delinquent State will lose all but a small portion.



## THE ROADS IN OUR FORESTS

By F. E. BONNER,

*Assistant Chief Engineer, United States Forest Service*

**F**EW people realize that in our National Forests every man has a great country estate, unrivaled by those of the richest, where he may enjoy himself without hindrance. There are no entrance fees, and the only dues consist of a reasonable requirement that he avoid carelessness with fire and observe common-sense cleanliness and sanitation about his camp, so that it may be presentable to the fellow traveler following him.

Uncle Sam, playing the rôle of manager of this great coöperative estate, in which every citizen of the United States is an equal stockholder, has his trials and problems like any other manager, but he is doing the best he can to open up the National Forests and make them fulfill one of their important functions as great summer playgrounds for all who wish to enjoy them. This is a large job, even for Uncle, who has grown accustomed to handling big things in a big way. By their very nature the National Forests embrace the most rugged, the most densely timbered and the least developed regions of the entire nation.

To begin with, these vast tracts were set aside chiefly with the idea of reserving what was left of our forested public domain so that the timber might be used under such policies as would insure a continuing supply for the future and to provide for water conservation. Along with the timber, however, the Forests contain a great abundance of forage for live stock and an unlimited opportunity for recreation.

The use of the Forests for recreation has advanced greatly in recent years with the increase of automobile travel, the progress of building good roads and the growing appreciation of the splendid opportunities for enjoying a vacation or short outing in the unending variety of delightful country which the National Forests offer. Here exists a great deal of the most incomparable mountain scenery with which America is favored. Towering snow-capped peaks, magnificent forests older than our modern civilization, glistening glaciers, graceful waterfalls, beautiful lakes, and tumbling streams in endless array. Here the fisherman may find the trout streams he has dreamed of, the mountain climber



*Courtesy U. S. Forest Service*

Road through virgin forest, Rainer National Forest, Pierce County, Washington.  
Red or Douglass Fir, Red Cedar, Oregon Maple, Western Hemlock



ascents that will test his skill and endurance to the utmost, the hunter may search out rare specimens of big game, and for all the rest of us there are the wonderful views, the great silences, the wild flowers and all the other varied attractions of life in the great open spaces so fascinating to every normal person.

Altogether there are now 148 individual National Forests, which are scattered throughout 27 States and in Alaska and Porto Rico. The most of the Forests lie, of course, in the eleven most Western States. The average size of a Forest is about 1,000,000 acres, or an area about 40 miles square.

The distribution of the National Forest area between States is as follows:

State	Number of Forests or parts of Forests	National Forest land Acres
Alabama .....	1	65,167
Alaska .....	2	20,579,336
Arizona .....	10	11,355,846
Arkansas .....	2	926,985
California .....	19	19,172,982
Colorado .....	17	13,290,354
Florida .....	1	317,511
Georgia .....	2	134,095
Idaho .....	19	18,712,241
Maine .....	1	32,143
Michigan .....	1	89,466
Minnesota .....	2	1,047,620
Montana .....	17	15,917,132
Nebraska .....	1	205,944
Nevada .....	8	4,945,550
New Hampshire .....	1	383,111
New Mexico .....	7	8,382,683
North Carolina .....	4	313,075
Oklahoma .....	1	61,480
Oregon .....	15	13,133,081
Porto Rico .....	1	12,443
South Carolina .....	1	18,454
South Dakota .....	3	1,076,754
Tennessee .....	2	213,425
Utah .....	12	7,421,191
Virginia .....	4	350,362
Washington .....	10	9,939,712
West Virginia .....	2	99,109
Wyoming .....	12	8,468,793

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Aggregate for the 148 National Forests..... 156,066,045

(Twenty-six Forests extend into two or more States.)

The great wealth of natural resources embraced within this extensive area is highly impressive. The standing timber aggre-



gates 563 billion board feet, or about 25 per cent of all the timber remaining in this country. The annual forage crops sustain for varying periods of the year about two million head of cattle and horses and more than seven million sheep. There are also the potential water power possibilities of the thousands of streams rushing and falling from the snow belts of the high ranges. It is estimated that about 16 million horsepower may be developed eventually and turned to perform useful work beyond present comprehension. In addition, there are the buried mineral resources, the value of which no man dare hazard a guess. Admittedly, though, the ceaseless quest for precious mineral has barely scratched the surface so far. Besides these definite resources, there are the more intangible values, such as the conservation of water and stream flow control, the protection of wild life, the recreation uses and many others.

A conservative estimate of the present value of the land and merchantable timber of the National Forests is more than a billion dollars. It should be understood that this estimate relates only to the bare worth of the land and timber and makes no endeavor to include a valuation for the water power and mineral resources nor for any of the intangible factors.

Contrary to a popular impression in some quarters, all these vast resources are not "bottled up" to be handed down to unborn generations, but are open now for development and exploitation by any citizen under reasonable and unburdensome restrictions merely adequate to protect the interests of the public and to insure a sustained production of forest products.

One of the most pressing needs of the Forests is for more adequate transportation facilities. Complete road systems are absolutely essential for the proper care and management of this far-flung estate, but even more important is the need for roads, that make the resources available for the demands of commerce and for full utilization by the people. At the present time the great bulk of the resources are relatively inaccessible and therefore practically without a market.

An illustration of this is found in the cutting of National Forest timber. The annual cut at present is only about 800 million feet out of the enormous total of 563 billion feet. The sale of even this much, however, returns more than \$2,000,000 a year to the U. S. Treasury. It is calculated from the rate of annual growth that the National Forests will readily support an annual cut of at least  $5\frac{1}{2}$  billion feet without depleting the supply. Figured merely at the present low stumpage rates, this would bring nearly \$14,000,000 a year into the public treasury. The logging of the great quantity of merchantable timber in the National Forests is

dependent chiefly on transportation. In some sections economic logging requires the construction of logging railroads. This is especially true in the heavily timbered regions of Washington and Oregon. There are extensive regions, however, where the logging is mainly dependent upon roads.

Somewhat similar to the timber situation is that in connection with the use of the forage resources. Large areas of excellent grazing land are now unused because of their being inaccessible to cattle and sheep. The construction of roads into these areas would provide summer range for a great deal of live stock and the revenue to the government from grazing leases thereby increased considerably.

It is the same way with utilization of the Forests for recreation. This use has increased enormously in recent years, not only by transient tourists and campers, but by a large number of people taking long-term leases for sites upon which permanent summer homes are established. With more extensive road improvement many highly attractive recreation regions now inaccessible will be opened up.

Back in 1905, when the Forest Service first became charged with the administration of the regions withdrawn for National Forests, it found many large areas almost wholly without transportation routes of any kind. These regions consisted of very rugged land covered with dense timber and brush practically untouched by the hand of man. The earlier visitors had consisted mostly of venturesome prospectors and trappers, whose efforts toward providing ways through the mountains contributed but little to those following. There were, of course, in the more open and less rugged regions some wagon and pack trails built by isolated mining companies or stock-raising interests and occasionally fair roads had been built between communities separated by the mountains.

Under the circumstances one of the first big tasks of the Forest Service was to plan out and begin construction on a comprehensive system of roads and trails. The funds available for such work in the earlier years were extremely limited and therefore the work was confined largely to building only the pack trails needed for the Forest officers to reach the more important localities.

As time went on the need of road development in the Forests became more clearly understood and in response to widespread interest in the subject Congress granted authority in 1912 for the Forest Service to expend on road and trail work 10 per cent of the annual receipts from the sale of timber and other forest products. This really furnished the start of the road building work in the Forests, which has been progressing at a rapidly accelerating rate ever since.





*Courtesy U. S. Forest Service*

**A National Forest road through the Mission Mountains, Idaho**



Often the National Forests cover like a blanket a great mountain range separating productive and populous valleys on either side. Soon after beginning the road work on a modest scale under the so-called "10 per cent fund" appropriation, there sprung up, hand in hand with the good roads movement sweeping the country, a call for government help in building the roads up through the rugged canyons and over the low passes on the summits to provide means of travel between the communities separated by the mountain ranges embraced in the Forests. Thus there developed a call for recognition by the Government of an obligation to aid in the construction of the National Forest roads principally useful as links in the State and county trunk highway systems.

Partially in response of this demand, Congress in 1916 made another appropriation of \$1,000,000 a year, running for a period of 10 years, for the Forest roads. This act is still in force and the last appropriation will be that for the fiscal year 1926. The appropriation under this act is termed the "Section 8 Fund." The expenditures are reimbursed to the Treasury from the Forest receipts.

In 1919 Congress recognized the need for more rapid progress on the building of the Forest roads and trails and passed the so-called "Federal Forest Road Construction" appropriation of \$9,000,000.

Again, in the fall of 1921, with the current funds nearing exhaustion, Congress appropriated \$15,000,000 for the Forest roads and trails. This Act specifically provided for two distinct classes of roads. First there was set aside under the designation of "Forest Highway Fund," \$9,500,000 of the appropriation for those roads in the Forests needed particularly for public travel and primarily important from the standpoint of completing the parts of the State systems and the county roads traversing the Forests. Thus does Congress recognize the obligation of the United States as a large land proprietor and reimburse the local agencies for the loss of taxable revenues from the areas permanently under Federal control. This is in addition to the provision in force since 1908, by which 25 per cent of the gross receipts from operating the National Forests is paid for road and school purposes to the counties containing National Forest area.

The other part of the new act set aside \$5,500,000, called the "Forest Development Fund," for the roads and trails needed primarily for the protection and development of the Forests themselves. This fund will allow substantial progress to be made on the roads and trails so necessary in the prevention and suppression of fire. A large number of fires are started by lighting far back in the mountains and under present conditions a force of fire fight-

AGGREGATE APPORTIONMENT FOR NATIONAL FOREST ROADS AND TRAILS INCLUDING INSTALLMENTS BECOMING AVAILABLE  
JULY 1, 1922

State	10% Fund	Sec. 8 Fund	Federal Forest Road Fund	Forest Highway Fund	Forest Development Fund	Total
Alabama.....	\$ 199.64	\$ 318,065.00	\$ 700.00	\$ 4,880	\$ 5,799	\$ 11,578.64
Alaska.....	69,384.39	318,065.00	148,386.00	970.271	50,222	1,556,328.39
Arizona.....	310,935.82	394,589.00	375,916.00	598,189	280,712	1,960,351.82
Arkansas.....	46,980.51	70,715.00	130,975.00	70,365	77,573	391,608.51
California.....	403,805.48	965,816.00	948,780.00	1,460,871	703,822	4,483,094.48
Colorado.....	292,139.96	451,624.00	596,563.66	717,058	336,360	2,393,745.62
Florida.....	13,824.92	78,678.00	23,596.00	25,118	8,730	149,946.92
Georgia.....	2,036.00	759,557.00	178,000.00	13,355	20,347	213,738.00
Idaho.....	347,508.22	759,557.00	1,180,432.00	1,097,894	1,088,656	4,474,047.22
Kansas.....	1,977.32	759,557.00	1,180,432.00	1,097,894	1,088,656	4,474,047.22
Maine.....	649.39	759,557.00	3,475.00	2,760	4,754	11,638.39
Michigan.....	719.39	759,557.00	3,000.00	3,638	6,220	13,577.39
Minnesota.....	13,221.65	759,557.00	106,000.00	60,929	65,621	245,771.65
Montana.....	324,815.27	492,379.00	638,870.00	878,886	574,615	2,909,565.27
Nebraska.....	9,290.81	759,557.00	45,424.00	11,065	11,159	31,514.81
Nevada.....	75,826.50	132,505.00	45,424.00	207,984	55,377	517,116.50
New Hampshire.....	8,424.80	759,557.00	9,775.00	35,294	24,276	77,769.80
New Mexico.....	189,219.13	277,568.00	436,525.00	458,258	219,652	1,881,222.13
North Carolina.....	9,898.41	92,139.00	159,178.00	27,856	46,984	336,055.41
North Dakota.....	156.79	759,557.00	2,500.00	5,645	8,764	21,129.00
Oklahoma.....	4,220.00	759,557.00	859,387.00	1,157,109	718,555	3,953,787.48
Oregon.....	316,370.48	902,366.00	3,300.00	1,454	5,344	10,101.70
Porto Rico.....	3.70	759,557.00	3,300.00	1,454	5,344	10,101.70
South Carolina.....	255.28	759,557.00	3,300.00	1,454	5,344	10,101.70
South Dakota.....	60,060.11	55,981.00	67,873.34	77,553	64,139	325,606.45
Tennessee.....	5,857.12	55,981.00	26,681.00	20,896	23,243	132,271.12
Utah.....	185,863.61	280,349.00	387,724.00	371,776	164,258	1,389,970.61
Virginia.....	9,654.41	40,000.00	69,000.00	26,140	46,512	191,306.41
Washington.....	180,547.65	635,840.00	614,519.00	708,133	602,889	2,741,928.65
West Virginia.....	1,235.77	759,557.00	3,000.00	6,051	14,602	24,888.77
Wyoming.....	157,165.87	296,235.00	501,807.00	479,000	267,101	1,701,308.87
Equipment.....	17,524.20	759,557.00	777,467.72	777,467.72	777,467.72	1,794,991.92
General Items.....	682,475.80	759,557.00	700,645.28	700,645.28	700,645.28	1,383,121.08
Total.....	\$3,042,248.40	\$7,000,000.00	\$9,000,000.00	\$9,500,000	\$5,500,000	\$34,042,248.40



ers may have to travel on foot for as much as four or five days to reach some of these fires. Success in fighting forest fires is dependent mainly on attacking the fires before they have a chance to become large conflagrations and nothing will contribute more toward this end than adequate highways.

The accompanying tabulation shows the distribution between States of the various appropriations for Forest roads available up to and including the installments forthcoming on July 1, 1922. No expenditures have been made yet from the \$15,000,000 appropriated in November, 1921, but altogether there has been expended so far on the Forest roads and trails in excess of \$20,000,000. Liberal coöperation has been provided in most regions by the State and local agencies concerned. The Forest Service studies carefully the respective merits of the many projects proposed and endeavors to select first those which are most urgent. Advantage is taken of the expert highway engineering training and experience of the Government Bureau of Public Roads to direct the surveys and construction of all the larger projects in order to insure effective results conforming with the best highway practice.

A big start has been made toward equipping the National Forests with the transportation systems needed, but an enormous amount of work still remains to be done. According to the best estimates made by the Forest Service, there is still necessary, to complete the State highway systems traversing or contiguous to the Forests, the construction of about 5,400 miles of relatively high class road. To complete the county roads in the Forests the construction of more than 8,000 miles is required and more than 13,000 miles of road is essential primarily for the utilization and management of the Forest lands. Besides the roads, 40,000 miles of trails should be added to the present system, principally for use in connection with fire protection work. The construction of these roads and trails will entail a further outlay of about \$140,000,000. The sum is considerable, but as the work progresses further along toward completion and the innumerable benefits become better realized, the people of America will appreciate that the investment is creating a national asset of inestimable value.



## ROAD BUILDING IN NATIONAL PARKS

By STEPHEN T. MATHER,

*Director, National Park Service*

OF the 19 national parks and 24 national monuments now comprising the national park system, 17 parks and 22 monuments are located in the United States proper. One national park is in Alaska and one is in Hawaii. There are two national monuments in Alaska. The following travel figures will indicate the part the national parks are playing in the development of highway travel. In 1916, 356,097 people visited 13 of the national parks; a year later 811,516 visitors came to 16 national parks and 6 national monuments; in 1920 travel to 17 parks and 11 of the monuments climbed to a total of 1,058,455 persons; and last year the travel to 18 parks and 13 monuments amounted to 1,171,797 persons.

And what is of the greatest interest, 65 per cent of the visitors last year came in private automobiles, and of these at least one-half brought their own camp equipment and camped out in the free public camp grounds provided for them. It has been surprising to note how many visitors are recorded from the East, these traveling the transcontinental highways to reach their destinations. From the recreational and educational standpoint there is nothing in this country that exerts such a strong appeal as the parks. They are the property of the United States and as such must be properly maintained and developed.

### Shortcomings of Some Existing Roads.

But, what is the situation that is encountered? In some of the parks lying in remote localities the park roads are sufficiently developed to be traveled in comfort by the motorist, while up to the park boundaries the roads, either under State or county control, are in deplorable condition. On the other hand, in some States there are excellent roads to the park entrances, and then inadequate roadways within. We invite travelers to the parks and are frequently confronted by just criticisms and complaints that either before or after they have reached the parks the roads are in wretched condition. Several of the most important park roads through the mountain passes are safe only for one-way



Auto roadway above Narada Falls, Rainier National Park



travel, so that at certain hours during the day travel is permitted to go only in one direction. In several parks long detours are required to reach one side of the park from the other because no through roads are provided.

Happily, due to the visit in 1920 of members of the Committee on Appropriations of the House of Representatives to some of the parks, several long delayed major road projects have been started, these being the Carbon River Road in Mount Rainier National Park, toward which \$50,000 was granted, and the beginning of the Transmountain Road in Glacier Park, toward which \$100,000 was given; this latter will be a half-million dollar project extended over a period of years. In all \$250,000 was granted last year toward the beginning of new road projects in three of the major parks, and these projects will undoubtedly be carried forward to completion. An additional amount of \$133,750 was granted for reconstructing sections of present roads in several of the other parks. There are, however, many other projects that must be recognized as urgent before our park roads may be considered complete; also, a number of the most important of the existing roads in the Yellowstone and Yosemite should be paved. We have not a single paved road in the national park system at this time.

#### **The National Park-to-Park Highway.**

In 1920 the great National Park-to-Park Highway was designated, including in one great circle the major national parks of the West, over which one may travel from park to park without a break except in such instances where no through roads have been provided. It is earnestly hoped that the several States, through which this highway passes, will include their sections for early improvement under coöperative arrangements for Federal aid.

#### **Park Roads Should Be Adequate.**

It is evident that in our national road development policy the national parks have been entirely overlooked, and that the time has arrived where provision should be included in appropriate legislation to give the parks proper recognition in Federal road legislation by not only providing adequately constructed feeders to the park gates, but good roadbeds beyond those gates. In my opinion, \$500,000 per year for a period of five years would enable us so to construct necessary roads within the parks, that when the important interstate roads and trunk lines have been completed our park roads will form a fitting climax to the trip, even as the scenery in our national parks and monuments never disappoints the visitor, no matter how far he travels. If this is done, the country will have not only a chain of splendidly con-



ceived and developed highways, but a proper development in our great recreation areas to which more of our people are finding their way every year.

### **Appropriations and Revenues.**

The total area of the national parks is 6,949,385 acres, or 10,859 square miles; the total area of the national monuments is 1,161,600 acres, or 1,815 square miles. Funds for the administration, protection, maintenance and improvement of the parks and monuments are appropriated annually by Congress. Congress, while always willing to appropriate funds for national park purposes, demands that those who use and enjoy these play-Under this general policy the national parks are made to earn a revenue each year from their operation, the bulk of which is derived, first, by the imposition of a fee charged private motorists for the use of the park roads, and second, from a percentage of the earnings of public utilities operating within the parks under franchises given by the government.

The entrance fee for automobiles is based on the mileage of automobile roads in the various parks and varies from 50 cents in the General Grant National Park to \$7.50 in the Yellowstone, where 303.55 miles of road are available for the use of motorists. In several of the parks where there is a small road mileage or where the roads have not been constructed by the government no entrance fee is charged. While a charge is made for the use of the roads, free public camp grounds have been established in each park where pure water is made available, sanitation facilities are provided and where the comforts of the camper are looked after.

Larger appropriations for continued and adequate park development will increase the popularity of the parks, which in turn would be reflected in increasing revenues derived from their operation. Eventually the parks should be practically self-supporting. The total revenues earned by the national parks during the fiscal year 1920 amounted to \$316,877.96, or to 37 per cent of the total appropriation granted for the same fiscal year. Revenues derived from the national parks, with the exception of those derived from the Hot Springs National Park, are turned into miscellaneous receipts of the Treasury. Revenues derived from the Hot Springs National Park are used in the administration and upkeep of that park, which is practically self-supporting. The following table gives some interesting statistics concerning the national parks:

### **First National Conference on State Parks.**

For the first time since park creation became a public question leaders in the movement to preserve choice places in the various



*Courtesy of the National Park Service*

**Road Between El Portal and Yosemite  
National Park, California**



## NATIONAL PARK STATISTICS

National Park	Location	Road Mileage	Road Maintenance Funds Fiscal Year 1920-1921	Road Maintenance Funds Fiscal Year 1921-1922	New Road Construction Funds Fiscal Year 1921-1922	Area Square Miles	Area Acres	Visitors Season 1921	Private Automobiles Entering
Hot Springs	Arkansas	10.00	\$ 3,000.00	\$ 3,000.00	.....	1½	911.63	130,968 <sup>a</sup>	1
Yellowstone	Wyoming Montana Idaho	361.55 <sup>a</sup>	102,000.00	87,700.00	\$ 27,750.00	3,348	2,142,720.00	81,651	15,756
Sequoia	California	52.00	5,000.00	3,600.00	50,000.00	252	161,597.00	28,263	7,139
Yosemite	California	138.00	40,000.00	60,000.00	37,500.00	1,125	719,622.40	91,513	18,947
General Grant	California	10.00	900.00	700.00	.....	4	2,536.00	30,312	6,545
Mount Rainier	Washington	35.00	10,000.00	7,000.00	100,000.00	324	207,360.00	55,771	12,271
Crater Lake	Oregon	57.00	11,400.00	10,830.00	.....	249	159,360.00	28,617	7,892
Wind Cave	South Dakota	6.00	875.00	2,000.00	.....	17	10,899.22	28,336	9,078
Platt	Oklahoma	5.00	330.00	790.00	.....	1½	848.22	60,000 <sup>a</sup>	21,848 <sup>a</sup>
Sully's Hill	North Dakota	1	.....	.....	.....	1½	780.00	9,100	.....
Mesa Verde	Colorado	45.00	4,000.00	4,000.00	.....	77	48,966.40	3,003	651
Glacier	Montana	140.00	25,500.00	24,500.00	100,000.00	1,534	981,681.00	19,736	2,614
Rocky Mountain	Colorado	75.00	6,300.00	11,000.00	25,000.00	397½	254,327.00	273,737 <sup>a</sup>	57,438 <sup>a</sup>
Hawaii	Hawaiian Islands	1	.....	.....	.....	118	75,295.00	16,071 <sup>a</sup>	1
Lassen Volcanic	California	1	2,450.00	2,500.00	.....	124	79,561.58	10,000 <sup>a</sup>	1
Mount McKinley	Alaska	.....	.....	.....	.....	2,200 <sup>a</sup>	1,408,000.00 <sup>a</sup>	1	1
Grand Canyon	Arizona	130.00	21,480.00	8,900.00	40,000.00	958 <sup>a</sup>	613,120.00 <sup>a</sup>	67,485	5,104
Lafayette	Maine	2.00	2,500.00	1,000.00	3,500.00	8 <sup>a</sup>	5,000.00 <sup>a</sup>	69,836 <sup>a</sup>	9,958
Zion	Utah	5.00	1,000.00	1,250.00	.....	120 <sup>a</sup>	76,800.00 <sup>a</sup>	2,937	604
Totals		1,071.55	\$236,735.00	\$228,770.00	\$383,750.00	10,859	6,949,385.45	1,007,336	175,825

<sup>a</sup> No record.<sup>a</sup> 58 miles of forest roads maintained as park approach roads.<sup>a</sup> Estimated.



States and under State control as centers of recreation, health, and education met in national conference at Des Moines, Iowa, on the 10th, 11th and 12th of January. This conference was called by Governor Harding of Iowa at the suggestion of the Secretary of the Interior. Over half the States had representatives present, and speakers from almost every corner of the United States appeared on the program to discuss special themes of nature interest.

The resolutions adopted by the conference follow:

The national conference on parks, assembled in Des Moines, January 10, 11 and 12, 1921, upon the call of the Governor of



*Courtesy of the National Park Service*

**Road near Many Glacier Hotel, Glacier National Park**

Iowa, and at the suggestion of the Secretary of the Interior, and in coöperation with the National Park Service, declares its belief:

1. That public parks, local, county, State, and National, are necessary for the best development of patriotism, of efficient manhood and womanhood, and of business and civic life in the United States.

2. That such parks should include not only ample and organized provision for recreation, but also for the preservation in their natural state of liberal areas embracing the varied types of prairie, forest, lake, river, and mountain scenery of America, as well as the natural wonders that distinguish our country.

3. That it is incumbent upon our governments, local, county, State, and National, to continue to acquire sites suitable for recreation and the preservation of wild life, until eventually there shall be public parks within easy access of all the people of our nation.

To facilitate such acquirement we recommend the appointment of a special committee to study the park laws of the several States and to confer with the executive committee of the national conference of commissioners on uniform State laws, with a view to the preparation and presentation of model drafts.

4. That this conference, recognizing the fundamental value of forest recreation, recommends the establishment of further National, State, county, and municipal forests and that the recreational use of such areas be correlated with similar activities in other publicly owned areas.

5. That either as public parks or monuments, important historic sites and trails (both Indian and colonial) should be preserved, marked, and maintained for the instruction and inspiration of this and future generations.

6. That all public parks, already acquired or later to be set aside, shall be considered as forever dedicated to the people and shall be held inviolate from commercial use and private gain.

7. That the creation of a sentiment favorable to the preservation of wild life, without as well as within our parks, is one of the great duties of our generation, and that the establishment of a conservation day—State or National—may be one of the surest means of developing such sentiment.

8. That it is important to develop a great system of intercity, interstate, and national park highways. Along these and other routes of travel it is desirable to protect wild life, especially trees and wild flowers, and to restore such life wherever it has been despoiled. It is particularly desirable to preserve large and characteristic trees along the highways to serve as memorials of the past.

9. That, as a means of cementing all park interests into a harmonious whole and to provide for further conference and exchange of ideas, this body recommends the adoption of a policy of an annual meeting of this character and recommends in particular the organization of a second conference on parks in 1922; in pursuance of this object it also recommends appointment of a committee which shall have power to make the necessary arrangements for this second conference.

10. This body expresses the hope that a way be found to publish the proceedings of this first national conference on parks, and for this purpose it recommends the appointment of a committee on publication.



11. This conference hereby expresses its grateful appreciation of their service to all who have made this conference possible.

Undoubtedly the first national conference on State parks will have far-reaching results. The State park movement, already so auspiciously begun, is bound to grow in popularity once its purposes become generally known, and the time will come when a State park will be available every hundred miles or so up and down the entire continent, offering not only some particularly choice bit of local native scenery or historic accent for the enjoyment of the traveler, but well-equipped camping places that will provide for his physical comfort.

As a result of the conference a number of States, among them Washington and Virginia, which have no State parks, placed bills for the creation of such parks before their legislatures at their last session. California's legislature has passed a bill appropriating \$300,000 for the purchase of Redwoods, in Humboldt and Mendocino Counties; Wisconsin has set aside about 7,800 acres of forested lake and river region as the Northern Lakes Park; and the Allegheny Park of about 50,000 acres in an historic and picturesque part of Cattaraugus County, N. Y., has just been established. These are but a few of the developments in State park establishment in the last few months.



# **HIGHWAY MANAGEMENT AND FINANCING IN THE VARIOUS STATES**

## **ALABAMA**

### **State Road Legislation**

Under the law, passed by the legislature in 1921, the State highway commission consists of the senior professor of civil engineering in the Alabama Polytechnic Institute, the State geologist and a member appointed by the governor from each of the ten congressional districts of the State. The commission deals with matters of general policy and acts for the highway department in all its relations with the governor and the legislature. The State highway engineer is chosen by the commission and holds office at their pleasure, but must be a competent engineer with six years' experience in actual charge of engineering work, not less than three of which shall have been in charge of highway construction. He is required to make a general highway plan of the State, collect information, determine the character and supervise the construction of roads built by the State and those built with the aid of the Federal Government.

The law provides that the State highway commission shall construct roads that lead from county seat to county seat of the various counties over the most direct and feasible routes, and for an equitable division of funds, labor and time between the various counties in the construction of such roads.

The commission has prepared a map showing the primary and secondary systems of roads first to be constructed. This system coordinates with trunk roads of border States and embraces 3,890 miles. The total road mileage in the State is estimated at 55,570.

In order to receive aid from a State a county does not necessarily have to appropriate any money, but the State highway commission may condition an appropriation of a sum of money for road construction in a county upon the county's appropriating a sum to be fixed by the commission. Under the old law contracts were awarded in the name of the county; under the new law all contracts will be made by the State of Alabama. The State has authority to maintain any road constructed by the State with State funds.

### **Local Road Legislation**

An elected board of county commissioners, consisting of the probate judge and four others, has jurisdiction over local roads,

but boards of revenue or like boards may be created by special statute to take the place of boards of county commissioners. A supervisor of roads for an entire county may be appointed by the board. The board divides the county into road precincts and appoints a road overseer for each precinct. Road taxes may be worked out in counties having less than \$100,000,000 assessed valuation.

### Bond Legislation

On September 27, 1919, the legislature passed an act authorizing an election 90 days or later after the adjournment of the legislature, to amend the State constitution so as to permit the issuance and sale of \$25,000,000 in State road bonds with which to build a system of State roads. Interest on these bonds are to be paid from the revenue derived from the sale of motor vehicle licenses. From this fund there shall also be created a sinking fund, as well as a fund for the maintenance of the roads.

The election was held February 16, 1920, and the amendment was adopted by a majority of approximately eight to one. The bonds cannot be sold for less than par and shall bear interest at not to exceed 5 per cent. Since this amendment was adopted a special session of the legislature called another election for the 21st of February, 1921, to determine whether or not the original amendment shall be so amended as to permit \$5,000,000 worth of the bonds to bear interest at a rate not to exceed 6 per cent.

About this time the State Supreme Court handed down a decision declaring the original amendment null and void because of the technicality. The Governor called a special session of the legislature in October, 1921, and the question of an amendment to the Constitution permitting the sale of \$25,000,000 in bonds was again submitted to a vote of the people. The election was held on January 30, 1922, and carried by a vote of approximately nine to one. The method of financing the bonds is the same as that provided for in the original act.

The court of county commissioners and board of revenue of any county may order an election on the issuing of county bonds to build roads or to pay debts created for the building of roads. After an election is held, another such election shall not be held within one year. A majority vote is necessary to carry. The amount of bonds shall not exceed  $3\frac{1}{2}$  per cent of the assessed value of property and shall bear not to exceed 5 per cent interest, shall be sold for not less than par value, and shall run for such time as may be fixed by the court of county commissioners and board of revenue. No specific provision is made by law for retiring the bonds, and this matter presumably is left to the discretion of the court of county commissioners and board of revenue.

### Convict Labor Laws

The convicts of any county or municipality may be worked upon the public roads, bridges or ferries of the county under the direction of the court of county commissioners, or they may be hired to other counties. State convicts may be hired by a county.

### Automobile Registration

Automobile licenses are issued by the probate judge of each county, who sends 20 per cent to the treasurer of the city, town or county where the licensee resides,  $77\frac{1}{2}$  per cent to the State treasurer, and retains  $2\frac{1}{2}$  per cent as commission.

License fees for private cars are: Under 25 h. p., \$11.25; 25-30 h. p., \$18.75; 30-40 h. p., \$26.25; 40 h. p. or more, \$30. The fee is based on the insurable horse power of the car.

For electric automobiles, other than trucks, the tax is \$20; for steam automobiles, \$25; motorcycles, \$5; motorcycles with side seats, \$7.50.

Automobiles, commercial.—Trucks less than 1 ton, \$25; trucks 1 to 2 tons, \$22.50; trucks 2 tons and less than 3 tons, \$37.50; 3 tons to 4 tons, \$56.25; 4 tons and over, \$75. No aggregate load exceeding 10 tons will be allowed on public roads.

Automobiles for hire.—With seating capacity of 5 persons, or less, \$37.50; seating 5 to 10, \$60; 10 persons or more, \$90.

### Road Funds

State highway funds are derived solely from receipts from motor vehicle licenses and registrations and from the State bond issue. During the year ending September 30, 1921, the receipts from the motor vehicle fund amounted to \$917,811.50. It is estimated that the receipts from this fund for 1922 will be about \$1,100,000. It is planned to spend about two and a half million dollars from the State bond issue during 1922. Aside from expenditures by the State highway department, the counties expended during 1921 about \$3,300,000 and it is estimated that they will spend approximately the same amount during 1922.

### Progress Report

Of the State highway system, 3,890 miles, it is estimated that 1,000 miles have already been improved or contracted for. The mileage type and cost of roads completed during 1921 is indicated as follows:



<i>Type</i>	<i>Miles</i>	<i>Cost</i>
Warrenite Bitulithic.....	3.0	\$ 145,394.00
Concrete.....	0.65	22,904.00
Bituminous macadam....	1.0	20,337.10
Macadam.....	11.5	125,381.55
Gravel.....	52.05	564,394.58
Sand Clay.....	21.00	122,061.00
Bridge construction.....		189,951.41
Grand total.....	89.20	\$1,000,472.23

The mileage and the cost of roads under contract December 20, 1921, is indicated as follows:

<i>Type</i>	<i>Miles</i>	<i>Cost</i>
Gravel and chert.....	150.05	\$1,453,850.52
Sand clay.....	34.42	212,546.74
Bituminous macadam....	9.00	183,033.90
Bituminous concrete....	8.89	228,041.56
Concrete.....	4.66	161,766.61
Macadam.....	20.78	170,048.97
Bridges.....	1933 Lin. ft.	475,952.69

Total 227.80 Miles involving..... 2,409,228.30  
 1933 Lin. ft. of Bridges..... 475,952.69

Grand total.....\$2,885,240.99

The construction program for 1922 is indicated as follows:

<i>Type</i>	<i>Miles</i>	<i>Estimated Cost</i>
Asphalt or concrete.....	27.71	\$ 947,938.00
Bituminous macadam....	88.12	1,888,926.00
Gravel.....	84.78	978,431.60
Sand clay.....	100.22	556,385.06
Bridge projects.....		531,000.00

Grand total.....300.83 \$4,902,680.66

The State has under construction at present 267 miles of roads estimated to cost \$3,044,422.

The program for 1921 embraces 320 miles of road, the estimated cost of which, including one bridge, is placed at \$5,693,729, of which the State's share, including the bridge, amounts to \$2,796,865. This program includes 65 miles of bituminous macadam, costing approximately \$1,820,999; 184 miles of gravel, costing \$3,046,045; 67 miles of sand-clay, costing \$539,195; 4 miles of asphalt pavement, costing \$124,558; and one bridge in Montgomery County, for which the 1920 expenditure is estimated at \$162,933. All of this work involves Federal aid on the fifty-fifty basis.

### Maintenance

The State maintained 248 miles of road during 1921 at a cost of approximately \$20,000. During 1922 the State plans to maintain about 400 miles of road. Receipts from the motor vehicle fund are used for the maintenance of these roads.

### State Highway Officials

State Highway Commission.—Hon. John Craft, Mobile, Ala.; Mr. F. J. Cramton, Montgomery, Ala.; Senator J. B. Espy, Abbeville, Ala.; Mr. S. P. McDonald; Senator O. T. Smith, Goodwater, Ala.; Senator John A. Rogers, Gainsville, Ala.; Mr. Thomas E. Orr, Albertville, Ala.; Mr. Andrew G. Patterson, Decatur, Ala.; Mr. S. R. Batson, Birmingham, Ala.; Marvin Pearce, Winfield, Ala.; Dr. E. A. Smith, University, Ala.; Prof. John A. Callan, Auburn, Ala.

State highway engineer, W. S. Keller. Headquarters, Montgomery.

Revised by W. S. Keller, State highway engineer.

### ALASKA

Road work in Alaska is under the direction of a Federal Board of Road Commissioners, the Department of Agriculture and the Territorial Board of Road Commissioners. The first two agencies have jurisdiction over the Federal work and the Territorial Board administers the territorial work.

#### Board of Road Commissioners for Alaska

The Board of Road Commissioners for Alaska, generally referred to as the "Alaska Road Commission," was organized May 15, 1905, by order of the Secretary of War, in conformity with an act of Congress approved January 27, 1905. The organization consists of three members, one of whom acts as president of the board and in general charge of operations, one as engineer officer responsible for the proper execution of all work in the field, and one as secretary and disbursing officer in charge of the office and all disbursements. From its inception until December 29, 1917, the board reported direct to the War Department, through the adjutant general of the army, but on the latter date orders were issued by the Secretary of War placing the work under the general supervision of the chief of engineers.

The act of Congress authorized the board, "upon their own motion or upon petition, to locate, lay out, construct and maintain wagon roads and pack trails from any point on the navigable waters of Alaska to any town, mining or other industrial camp or settlement, or between any such town, camps or settlements therein, if in their judgment such roads or trails are needed and will be of permanent value for the development of the district." In accordance with this authority, the board has from time to time undertaken the construction of new roads and trails, with a view to rendering reasonably accessible all parts of the Territory, and aiding in the early development of the productive sections.



Unexpected discoveries of mineral deposits in different parts of the Territory and the likelihood of further discoveries have made the adoption of a fixed project impossible, but practically all of the roads and trails west of the 141st meridian have been laid out so as to form part of a connected system, covering nearly all of the developed portions of the Territory.

The act carried with it a provision for the expenditure of 70 per cent, later reduced to 65 per cent, of what is known as the Alaska fund, derived from Federal vocational and trade license taxes outside of incorporated towns. This fund proved to be so entirely inadequate, as well as so uncertain in amount, that the president of the board at the end of the first season set forth the situation in a special report. The Secretary of War took the matter up with Congress, with the result that an appropriation of \$185,000 was made for the fiscal year 1907 in aid of the work. Annual appropriations, varying from \$100,000 to \$500,000, have been continued to date.

By 1913, sufficient work had been done to warrant consideration of a general program of road and rail development. After a general overhauling of the situation the board submitted a recommendation that \$7,250,000 be appropriated during the next ten years so as to provide Alaska with a complete road system such as immediate needs justified, and sufficient to meet all reasonable demands until the territory should be sufficiently developed to take over internal public works as a part of its own government. This recommendation was to provide for—

- (a) The maintenance of the existing routes.
- (b) Completion of the projects already undertaken.
- (c) Completion of projects already approved but not yet undertaken.
- (d) Completion of projects likely to arise with the development during the succeeding ten years.

By 1916, Congress reached favorable consideration of this project and appropriated \$500,000 for that year. An equal amount was secured in 1917. Then the war came along and appropriations were cut to merely nominal amounts. As a result large sections of the old system were not kept in repair and some sections became impassable.

In 1920, the board was reorganized and prepared a new ten years program which has the support of the Governor of Alaska, the Territorial Road Commission, and the Interdepartmental Alaska Board in Washington. This program, in addition to the considerations entering into the 1913 program, had to take into account the following new elements in the problem:



- (a) Increased cost of labor, materials and supplies.
- (b) Need for the reconstruction and rehabilitation of a large portion of the old routes.
- (c) Requirement for a more substantial type of construction and a road so surfaced as to stand light truck traffic.
- (d) Necessity for a system of feeders to the Government railroad.

This program called for an initial appropriation of \$1,200,000 increasing to \$1,600,000 for the third year, and then tapering off to \$450,000 for the tenth year, by which time Alaska should have developed to such an extent as to take over the major portion of her road and trail construction as a part of her own interior development. The above estimates are for the direct appropriations of Congress and are exclusive of moneys accruing from the Alaska tax fund or from appropriations by the Territorial legislature.

The amount expended on all projects from January, 1905, to June 30, 1921, was as follows:

Construction .....	\$3,727,249.69
Maintenance .....	2,276,812.27
Total .....	<u>\$6,004,061.96</u>
Unexpended balance .....	537,407.13

Of this amount \$3,830,000 was appropriated by Congress, \$2,482,204.54 was received from the Alaska fund and \$229,264.55 was contributed by the Territorial legislature. During the fiscal year ending June 30, 1921, \$234,545.18 was expended for maintenance and \$432,243.90 for construction, a total of \$666,789.08.

The result of the expenditure is a total mileage of roads and trails aggregating 6,290 miles. Of this amount 3,766 comprise a connected system reaching from Valdez on the coast and Chitina on the Copper River railroad, to Eagle, Fairbanks and several settlements above the Arctic Circle, to the Lower Yukon, Nome, Candle, and Bering Straits. This system is joined at several points on the Yukon River by a secondary connected system of 1,736 miles, which begins at Seward, on the coast, and serves the Iditarod, Ophir and Innoko districts. In addition to this 5,502 miles of connected roads, there are 788 miles of short local roads and trails in various other parts of the Territory.

Practically all of the roads and trails are used as mail routes and by far the greater part of the system furnishes the only means of communication in this vast territory. Of this total, 1,101 miles are classed as wagon road, 756 as winter sled roads, 3,721 miles of permanent trail and 712 miles of temporary flagged trail. Approximately 600 miles of wagon road have a light gravel surface.

About 500 automobiles and trucks are used in the Territory. While funds have not permitted the construction of automobile roads, nevertheless 90 per cent of the summer traffic is handled by motors.

The average cost of wagon road, including maintenance, to date is approximately \$4,300 per mile; sled road, \$450 per mile, and trails \$150 per mile.

The headquarters of the commission are located at Juneau. The Territory is divided into five districts. The southeastern district comprises that part of Alaska south and east of the 141st meridian; the Valdez district, the country west of the 141st meridian, running as far north as Rapids on the Valdez-Fairbanks road, and bounded on the west by the 148th meridian; the south-western district, the territory between the 148th meridian and Kuskokwin River, including the Tacotna and Ophir sections. The Yukon district begins at the north boundary of the Valdez district at Rapids, and includes all work along the Yukon River, the country around Fairbanks, and the Tanana River Valley. The Nome district is confined to the Seward Peninsula.

Each district is in charge of a district superintendent, the superintendents also being bonded disbursing clerks. Under each superintendent are foremen in charge of working crews on different projects. The crews are often working far from headquarters and the distances are so great and means of transportation so uncertain and slow that it is difficult for the superintendents to visit all of the projects in their districts. As the principal working season begins in June and ends in October, the superintendent is a busy man and his efforts are necessarily confined to the most important projects.

Under the coöperative road act of April, 1919, the President of the Board also acts as consulting engineer for the Territory on all matters relating to public works. He supervises the activities of the Territorial Divisional Road Commission and certifies vouchers for payment to the Territorial Board.

The members of the board are:

Major James G. Steese, Corps of Engineers, President.

Major John C. Gotwals, Corps of Engineers, Engineer Officer.

Captain Charles S. Ward, Corps of Engineers, Secretary and Disbursing Officer.

### Department of Agriculture

Under the provisions of section 8 of the Federal aid road act the system, as planned, embraces a total of 256 miles of road and trails limited to the Tongass and Chugach national forests. On July 1, 1919, \$245,451 of Federal funds were available for this work. As the Territorial law did not permit coöperation as re-



quired under the terms of the Federal aid act, no construction could be undertaken until the legislature passed a law meeting the requirements. In April, 1919, a law was passed giving the Territorial board of road commissioners (composed of the governor of the Territory, surveyor general and Territorial treasurer) authority to enter into coöperative agreements with the board of road commissioners for Alaska and the Secretary of Agriculture. This law has permitted the closest coöperation.

The Federal work was centralized during the first year (February, 1920) as the president of the board of road commissioners for Alaska was also the representative of the Department of Agriculture on all work coming under the provisions of the Federal aid road act. Six projects, aggregating 33 miles, were handled in 1920. For the fiscal year 1921, 9 projects, aggregating about 60 miles, were under construction. For the working season of 1921 about \$100,000 of Department of Agriculture funds were available.

The construction carried on by the Department of Agriculture is limited to the Tongass and Chugach National Forests in southeastern and southwestern Alaska. These projects are former projects of the Alaska Road Commission, but are now being carried on as coöperative projects by the Department of Agriculture with its own funds matched by funds of the Territory. This releases Alaska Road Commission funds for expenditure in parts of the Territory to which Department of Agriculture funds are not applicable.

Coöperation is extended within the limits of available funds when the Territory allots 25 per cent of the total cost of any project within the boundaries of the national forests. The Territorial Road Commission and the Forest Service determine what projects shall be carried out and the funds allotted by them for the purpose are then turned over to the U. S. Bureau of Public Roads which proceeds with the work of actual construction. Approximately 56 miles of roads have been constructed,—45½ miles of which are standard 14-foot automobile highways and the remainder sleigh roads.

Chas. H. Flory, Forest Supervisor.

Chester W. Cheatham, Sr., Highway Engineer, Bureau of Public Roads.

### **Territorial Board of Road Commissioners**

By act of the Territorial legislature, session of 1919, the Territorial board of road commissioners is composed of the governor, surveyor general, and Territorial treasurer, who have general supervision over the Territorial road work.

The Territory is divided into four divisions, which correspond to the four judicial divisions. Four hundred thousand dollars



were appropriated for the period of two years, \$100,000 being allotted to each division. The road law authorizes the Territorial board to enter into coöperative agreements with the board of road commissioners for Alaska and the Secretary of Agriculture for the construction, repair and maintenance of any public road, bridge or ferry within Alaska. During the two seasons provided for, \$184,685.08 were allotted for coöperative work with the board of road commissioners for Alaska and \$109,000 for coöperation with the Department of Agriculture under the provisions of section 8 of the Federal aid road act. Approximately \$200,000 was allotted each year, the remainder of the \$400,000 being expended by the chairman of the four divisional road commissions, composed of a chairman elected by popular vote, and two members appointed by the governor. The law provides that after March 1, 1921, the chairman shall be appointed by the governor and two other members of the divisional commission shall be elected by popular vote.

Under the Territorial Act of April 21, 1919, superintendents of the Alaska Road Commission in the 3rd and 4th divisions have been appointed chairmen of the Territorial Division Road Boards. The funds are disbursed upon territorial vouchers but the work is supervised by the officials of the Alaska Road Commission. The Territory thus secures the benefit of the extensive organization and the equipment of the Alaska Road Commission without any cost for overhead.

The Territory is also coöperating with the Alaska Road Commission in road construction in the 2nd division, in the construction of the Tacotna-Ophir road in the Kuskokwim District of the 4th division, the Talkeetna-Cache Creek road in the 3rd division and in connection with several small projects in the 1st division. The road law of the Territory has also been a great aid to the Alaska Road Commission in extending coöperation upon important projects. In the springs of 1920 and 1921, the acts for support of the army which carry the Federal appropriation for the Alaska Road Commission were passed so late that it would not have been possible for the Alaska Road Commission to initiate its work and take full advantage of the short working season had the Territory not allotted to it a substantial portion of its own funds.

The last session of the legislature appropriated \$240,000 for the biennium ending March 31, 1923, and also passed two special acts, one appropriating \$25,000 for the construction of a bridge over the Nizina River and providing for its construction under a coöperative agreement with the Alaska Road Commission, and the other authorizing the Alaska Road Commission to negotiate for the purchase of the Seward Peninsula Railroad for and in

behalf of the Territory, and then to maintain and operate it as a public tram and highway and appropriating money therefor.

A review of the report of the Territorial Road Commission for 1920 shows conclusively that the coöperative plan of constructing roads provided for by territorial law results in a more equitable distribution of funds, prevents duplication and makes possible the maintenance of one well coördinated organization with collective funds at its disposal to more effectively develop an adequate system of roads in the Territory.

The Federal Government has offices at convenient points, and as there is no overhead charge on coöperative work it is quite an advantage to the Territorial officials to do most of their work in coöperation with the Federal authorities.

The members of the Territorial board are—Scott C. Bone, Governor, Chairman of the Board; Karl Theile, Surveyor-General, Secretary of the Board; Walstein G. Smith, Territorial Treasurer, Treasurer of the Board; James G. Steese, President of the Board, Alaska Road Commission, Consulting Engineer.

Prepared by James G. Steese, major, Corps of Engineers, President Board of Road Commissioners, Juneau, Alaska.

## ARIZONA

The State highway department is administered by the State engineer, who is appointed by the governor for a term of two years. He is assisted by an assistant State engineer, in special charge of the Federal aid; a chief clerk in charge of accounting, records, etc. The department is further sub-divided, a chief locating engineer, chief construction engineer, chief engineer of maintenance, office engineer, bridge engineer and engineer in charge of testing, being in charge of their respective lines of work.

The department also has a superintendent of equipment, general storekeeper and master mechanic, who are all located at the central depot, and technical and clerical assistants are appointed by the State engineer or by the heads of the various departments. The former position of division engineer has been abolished and in its place competent engineers have been assigned to each major project, under whom are necessary resident engineers.

The State highway department has charge of the construction of all work financed wholly, or in part, with State or Federal funds, and on request acts in an advisory capacity to local officials. A system of State highways comprising approximately 1,600 miles has been laid out by the State engineer. These roads are improved under the direction of the highway department with State, Federal and county funds. State highways when completed are maintained by the State.



The highway department has made application for Federal aid on practically every project undertaken since 1919. The amount of Federal aid available exceeded the amount of State funds so that the State department coöperated with the county highway commissions in the construction of roads, in order to take advantage of all available Federal funds. All Federal aid is being applied to the State highway system.

### **Local Legislation**

The county boards of supervisors have jurisdiction over local roads. They may appoint a county engineer at a salary not exceeding \$3,000 per year.

Boards of supervisors may levy a regular tax at a rate not exceeding 25 cents on the \$100, the proceeds to be expended by the board. The assistance and advice of the State engineer may be requested in the expenditure of this money. A \$2.00 poll tax is also levied by counties, and the highway commissions and boards of trustees for districts may levy special taxes for road purposes within their jurisdiction.

### **Bond Legislation**

Bonds may be issued by the county boards of supervisors when authorized by a majority vote of the property tax paying voters, when a county highway commission has been legally constituted. These commissions consist of five members appointed by the board of supervisors to have charge of the expenditure of funds derived from the sale of bonds. Such commissions may appoint an engineer and other assistants to take charge of road work. The bonds must be of the serial type, bearing not to exceed 6 per cent interest, and may not run longer than 40 years.

Sinking fund bonds bearing not to exceed 6 per cent interest when authorized by two-thirds majority of the property tax paying voters affected, may be issued by the trustees of legally constituted special road districts.

### **Convict Labor**

State convicts may be used on State highways and bridge construction under the prison law, which provides \$60,000 annually for meeting the cost of such labor. In addition, the prison maintenance fund pays into the State road fund an amount equal to the expense of keeping the number of prisoners employed on the State highways and bridges.

### **Automobile Registration**

The Secretary of State has charge of registration, the rate being \$5 for 25 h.p. and less; 25 to 40 h.p., \$10; more than 40



h.p., \$15; for trucks of less than 1½ ton capacity, \$10; for trucks of not more than 3 ton capacity, \$15; for trucks of over 3 ton capacity, \$25; and for motorcycles, \$2.

### State Road Funds

A tax of one-half mill on each dollar of the assessed valuation is levied annually within the State for the purpose of raising a fund to be known as the State road fund for use in the construction and maintenance of State highways and bridges. This fund produces approximately \$400,000 per annum. Twenty-five per cent of this money is expended upon the authority and under the direction of the State engineer. Seventy-five per cent of the fund must be spent in the respective counties in which it is raised upon the authority and under the direction of the county board of supervisors and the State engineer. The receipts from automobile licenses go into what is known as the 25 per cent State road fund. They produce about \$200,000 per annum. A tax of one cent per gallon on gasoline will yield about \$150,000 per annum.

### Progress Report

A 7 per cent system consisting of 1,428 miles of road has been submitted to the Secretary of Agriculture. This includes the Old Trails Highway, crossing northern Arizona; the Bankhead Highway, crossing southern Arizona; a road from Phoenix to the New Mexico line via Superior, Miami, Globe, Safford and Duncan; a road from Tucson to Nogales, and a road from Phoenix to Prescott and Ash Fork. This system should be completed in about two years.

### State Highway Officials

Thomas Maddock, State Engineer; F. N. Holmquist, Assistant State Engineer; W. J. Jamieson, Office Engineer; C. C. Small, Chief Locating Engineer; E. A. Wolfe, Chief Construction Engineer; I. P. Fraizer, Chief Maintenance Engineer; Merrill Butler, Bridge Engineer; W. R. Ingraham, Chief Clerk; E. C. Moore, Purchasing Agent.

Revised by F. N. Holmquist, Assistant State Engineer.

## ARKANSAS

### State Highway Legislation

The State highway commission consists of three members, made up of the commissioner of State lands, highways and improvements, chairman; and two members appointed by the

governor, who serve two years, the term of one member expiring each year.

There is an advisory board to the highway department, composed of the State highway engineer, the head professor of civil engineering of the University of Arkansas, who is ex-officio consulting engineer of the highway department, and a member appointed by the governor.

The commissioner of State lands, highways and improvements appoints a State highway engineer subject to the approval of the commission. The engineer must be a graduate in engineering of some reputable school of engineering and skilled in road building.

The highway improvement fund is derived from motor vehicle fees and licenses and a tax of one cent per gallon on gasoline. This fund is used for the support of the highway department and, together with Federal aid, is apportioned to counties or projects by the State highway commission on approval of the advisory board.

The department is required to collect data, to see that road laws are enforced, and to hold road institutes at least once a year, which county judges, county engineers and road overseers are required to attend, and for which they receive the same pay as if they were engaged in actual work. The department is required to furnish plans and specifications when requested to do so, and to aid in the formation and management of highway improvement districts.

Highway improvement districts are created on application to the county courts, giving description of the roads to be improved and the territory traversed by them.

Under an act approved in March, 1917, the State highway department is given authority to take advantage of Federal aid and to cooperate with the Federal Government. The State's share of the funds are derived from the highway improvement fund appropriated by the legislature and from the funds of the various road improvement districts to which the aid is granted.

The State commission allots State and Federal aid funds to the various road improvement districts upon recommendation of the advisory board.

There are in the State 70,000 miles of public roads, classified as follows: State roads, 1,032 miles; Federal primary roads, 2,100 miles; Federal secondary roads, 2,800 miles, and county roads, 64,168 miles.

### Local Legislation

The county judge has original exclusive jurisdiction over the county roads. Overseers and commissioners of county and township roads are either elected or appointed, depending upon the law affecting each county.



The per capita road tax may be worked out. A 3-mill road tax on all assessed property is collected in cash. Special assessment districts for road construction may be formed upon petition of a majority of the property owners. The cost is assessed upon the property and the work done under the supervision of three commissioners, who receive not more than \$5 per day each for the time actually employed. The approximate amount of money raised from these sources during 1921 was \$1,500,000.

### **Bond Legislation**

An act approved March 30, 1915, provides for the formation of road improvement districts and for floating bonds (the life of which are not to exceed 30 years) for the purpose of building, constructing and maintaining highways. The board of commissioners of a road improvement district may issue bonds to be retired either serially or by a sinking fund. Under this act the highway department is required to make preliminary surveys, plans, specifications and estimates of cost when petitioned by 10 or more land owners or the county judge for the purpose of organizing a road improvement district.

### **Convict Labor**

The highway commission may employ as many of the State convicts on the public roads as may not be otherwise employed by the penitentiary authorities, the expense to be borne by the county or improvement district in which they work.

County convicts may be worked upon the highways of a county. Special road improvement districts may use convict labor and pay a flat rate of 75 cents per day to the county.

### **Automobile Registration**

Automobiles are registered annually with the commissioner of State lands, highways and improvements. The fees are as follows: 25 cents per h.p. and 25 cents per 100 pounds weight of vehicle and load, 150 pounds being added for each passenger. The rates on trucks equipped with pneumatic tires range from \$15 for a one-ton truck to \$150 for a six-ton truck. For three to six ton trucks equipped with two or more solid tires the rate is 1½ times the above schedule. There is also a tax of 1 cent per gallon on gasoline.

Thirty per cent of the revenue derived from registration fees (now about \$800,000) and 50 per cent of the receipts from the gasoline tax is deposited to the credit of the highway improvement fund of the State. The balance is retained for the construction and maintenance of county and road improvement district roads.



### Road Funds

*Amount of State funds expended during 1921:*

State aid automobile license fee and gasoline tax.....	\$235,000
Local district funds expended partly under State direction.....	22,000,000
District funds and State and Federal aid.....	12,000,000

### Progress Report

COMPLETED, UNDER CONSTRUCTION AND PROPOSED, 1921

Type	Miles	Estimated cost including grading and structures	Estimated expenditures in 1921	Approximate funds available for 1922
Earth.....	905.21	2,800,000	700,000	300,000
Gravel.....	3077.55	35,000,000	9,550,000	5,700,000
Macadam.....	395.39	4,500,000	2,000,000	500,000
Surface treated gravel.....	30.70	500,000	250,000	100,000
Asphaltic macadam.....	350.80	7,500,000	1,000,000	2,500,000
Asphaltic concrete.....	249.89	10,500,000	5,000,000	400,000
Concrete.....	245.77	11,000,000	2,500,000	1,500,000
Surface treated macadam.....	77.11	2,000,000	1,000,000	1,000,000
	5332.42	\$73,800,000	\$22,000,000	\$12,000,000

*Work Accomplished on State and Federal Road System to December 1, 1921*

	<i>Miles</i>
Roads surfaced.....	1662
Roads under construction.....	960
Roads completed as graded roads.....	288
Roads provided for by existing laws.....	518

### SUMMARY SHOWING ALL WORK COMPLETED

Type *	Miles proposed	Miles completed to Dec. 1, 1920	Miles completed during 1921	Miles to be completed
Graded.....	905.21	180	386.17	339.04
Gravel.....	3077.55	273	1349.92	1454.63
Macadam.....	395.39	47	159.11	189.28
Surface treated gravel.....	30.70	10	12.70	8.00
Surface treated macadam.....	77.11	20	22.20	34.91
Asphaltic macadam.....	350.80	48	44.68	258.12
Asphaltic concrete.....	249.89	17	207.69	25.20
Concrete.....	245.77	20	63.57	162.20
Totals.....	5332.42	615	2246.04	2471.38

### State Highway Officials

Officials of the Department of State Lands, Highways and Improvements: Herbert R. Wilson, Chairman; J. S. Turner, W. A. Falconer, Commissioners; Guy A. Freeling, Secretary; R. C. Limerick, State Highway Engineer. Headquarters, Little Rock.

Revised by R. C. Limerick, State Highway Engineer.

## CALIFORNIA

### State Highway Legislation

State road work is under the general direction of the State department of public works. It is directly administered by the California highway commission, a sub-division of that department. The State highway engineer, appointed by the governor, is the executive officer of the commission, and in his charge is placed the construction of the State highway system.

The people of California have adopted three State highway bond issue propositions involving \$73,000,000, the first known and cited as "State Highway Act," in amount \$18,000,000, at the general election of 1910; the second, "State Highway Act of 1915," in amount \$15,000,000, at the general election of 1916; and the third, in the form of an amendment to the State constitution, in amount \$40,000,000, at a special election held July 1, 1919.

The State highways, in the language of the first bond act, are to be acquired and constructed through the Sacramento and San Joaquin valleys and along the Pacific Coast, and connecting county seats lying east and west of the main routes. The second bond act added eight specific extensions to the original system. The third bond measure provides for the completion of the original system, the eight extensions provided by the act of 1915, and 30 additional road projects particularly described in the new bond proposition of 1919.

The total mileage of public roads in California exclusive of the roads within the limits of the incorporated cities and towns is 70,000 miles. Total miles in State highway system is 6,400 miles, including approximately 946 miles of special act roads maintained by the State. Roads improved or contracted for, 3,007 miles.

The entire system is to be constructed and maintained at the expense of the State. The cost of maintenance is provided for through funds derived from the State license fee imposed upon motor vehicles.

The State department of public works has general authority over all participation by the State in works of highway improve-



ment, and is given authority, acting through the California highway commission, to make investigations regarding highway betterment or extension which may be deemed desirable. In addition to the system of State highways, provided by the bond issues, appropriations have been made from time to time by the State legislature for construction of roads of State importance, particularly in mountainous sections and in localities where the sparse population makes the expense an undue legal tax burden.

**Federal Cooperation.**—Under the Federal aid act there is allotted to California a total sum of \$10,846,000, of which \$2,434,000 is available to and including the fiscal year 1919, \$2,896,000 for the fiscal year 1920, \$3,054,000 for the fiscal year 1921 and \$2,462,000 for the fiscal year 1922.

### **Local Legislation**

County supervisors, of whom there are five in each county, elected for a term of four years in November for even years, have authority over roads. The county surveyor is elected.

County revenues for road improvement are derived principally from a tax on property at rates not to exceed 40 cents on each \$100 and from one-half of the net automobile revenues.

### **Local Bond Legislation**

Upon petition of 10 per cent of the freeholder electors of any county, praying that the issuance of bonds for highway purposes be submitted to the electors, the county supervisors may appoint a highway commission of three members to investigate the main roads and report to the board those roads that should be improved, their estimated cost and the amount of bonds to be issued. If this report is approved by the board, an election on the issuance of the bonds must immediately be called. A two-thirds affirmative vote of the qualified electors is required. The term and rate of interest is not specified in the act. All work done with the proceeds of the bond issue shall be under the direction of the highway commission.

The county supervisors of any county may create road districts, under two different acts. A permanent road district (act of March 19, 1907) may be created upon the petition of a majority of the land owners of the proposed district, who may, in their petition, propose a bond issue for certain road improvements. This proposition must be submitted by the supervisors to the electors of the district, and if two-thirds of the votes cast are favorable, bonds of the district shall be issued not to exceed 15 per cent of the assessed valuation, to run not to exceed 20 years, at not to exceed 7 per cent per annum.



A special road district (act of March 21, 1907) for certain specified improvements on established roads may be created by the county supervisors after giving notice of the proposal, if a majority of the land owners of the proposed district do not file objections prior to the date set for hearing objections. Upon the creation of the district contracts under the approved specifications shall be awarded to the lowest responsible bidder and, upon the completion and acceptance of the work, bonds of the district shall be issued to pay for this work, to run not to exceed 20 years, and bear interest not to exceed 7 per cent.

Under both acts a tax must be levied to pay interest and principal when due, although in the case of bonds issued by a special road district the county supervisors may make transfers of funds for the payment of interest and principal when due.

### **Convict Labor Law**

An act authorizing the use of convict labor on State highways was passed in 1915. Upon the requisition of the department of public works, the State board of prison directors shall send to the place, and at the time designated, the number of convicts requisitioned, or such portion thereof as are available in the judgment of the warden. The department of public works designates and supervises the work done and provides and maintains necessary camps and commissariats. The State board of prison directors has full jurisdiction over the discipline and control of the convicts employed. The convicts are compensated by a reduction of their time to serve in prison, not to exceed one day for each two calendar days that the convict is absent from the prison.

### **Automobile Registration**

Annual registration is required, the application to be forwarded to the motor vehicle department with fee, which issues number plates, etc., and makes record. Registration fees are as follows: For every automobile, except electric automobiles, 40 cents for each h. p.; motor vehicles equipped with other than pneumatic tires and used for commercial purposes, according to weights, a graduated fee, in addition to the regular fees; electric motor vehicles, \$5; motorcycles, \$2; dealers, for each 5 cars operated, \$25, and \$2 for every automobile in excess of 5 so operated, including the necessary number of plates; motorcycle-dealers, \$5; chauffeur's license, \$2.

### **Road Funds**

The maintenance of the State and certain county roads is taken care of by the fund collected from the license tax on motor

vehicles. After deducting the cost of licenses and collection, half the money is used for the maintenance of State highways and the other half divided among the counties of the State in proportion to the amount collected from each county for licenses, this amount to be used in the maintenance of county highways. In 1921 approximately \$6,485,000 (net total) was collected. Funds for the construction of State highways are derived from State bond issues.

*Source and Amount of Funds Expended in 1921*

State Highway Bonds.....	\$9,366,721.90
Motor Vehicle Fund .....	3,303,446.76
Special Appropriations .....	25,463.84
Contributions .....	95,132.96
Federal Aid .....	1,569,154.89
Total .....	\$14,359,920.35

*Estimated for 1922*

State Highway Bonds.....	\$12,000,000.00
Motor Vehicle Fund .....	3,500,000.00
Federal Aid .....	2,500,000.00
Total .....	\$18,000,000.00

### Progress Report

The State highway work has been in progress since the spring of 1912. On January 1, 1922, the system included 2,292 miles of completed highways of the following types: Concrete base with asphalt surfacing, 85 miles; macadam base with asphalt surfacing, 16 miles; concrete base with and without thin bituminous surfacing, 1,382 miles; bituminized macadam, 205 miles; bituminous pavement, 16 miles; graded roads otherwise unimproved, 588 miles. Unfinished roads: With concrete base, 224 miles; bituminized macadam, 46 miles; macadam base and asphalt surface, 2 miles; concrete base with asphalt surface, 74 miles; bituminous pavement, 20 miles; unfinished graded roads otherwise unimproved, 349 miles. In addition to the above, there are 946 miles of special act roads maintained by the State.

*Highways Constructed or Contracted for During the Year 1921*

	Miles	Average Cost Per Mile
Graded Roads .....	304	\$12,000
Bituminized Macadam .....	46	21,000
Macadam Base Asphalt Surface.....	2	15,000
Concrete Base .....	201	30,000
Asphalt Surface on Concrete Base.....	83	10,500
Bituminous Pavement .....	20	24,000

During 1921 there were 3,238 miles of road maintained by the State, at a total cost of \$3,151,924. The State expects to maintain 3,950 miles during 1922, at a cost of about \$3,500,000.



### State Highway Officials

State Highway Commission, Sacramento.—Newell D. Darlington, Los Angeles, chairman; Charles A. Whitmore, Visalia; George C. Mansfield, Oroville. Austin B. Fletcher is the State highway engineer and executive officer of the commission, and C. C. Carleton of San Diego is the acting secretary. Division offices are maintained in San Francisco, Los Angeles, Dunsmuir, Fresno, San Luis Obispo and Willits.

Revised by A. B. Fletcher, State highway engineer.

## COLORADO

### State Highway Legislation

The State highway department consists of the governor, a State highway engineer, a highway advisory board of seven members, and such engineers, assistants, clerks and other employees as may be necessary to carry out the provisions of the State highway act. The State highway engineer is appointed by the governor, as are also the members of the advisory board, who represent the seven districts into which the State is divided. The terms of the advisory board members are three years and are not all concurrent. The State highway engineer is the chief executive officer of the department and has complete control of all work done by the State on State highways.

The total public highway mileage of the State is 48,000. Of this mileage, 8,135 miles have been selected as State roads, under the supervision of the State highway department. Of the State roads, 1,100 miles have been improved, and contracts for the improvement of 220 additional miles have been let and are under way.

On or before the 15th of November of each year, the advisory board furnishes the highway engineer such figures, estimates, data and other information as they deem advisable from which the highway engineer makes a budget covering the expenditures for the ensuing year. After review by the advisory board the budget is submitted to the governor not later than December 15th, and when his approval is obtained this becomes the final budget for the expenditure of all State highway funds for the year covered.

*Federal Aid.* The Federal aid program for 1921 and 1922 covers 49 new projects, and 49 projects for which contracts have been let in the year 1920-21 but all work not completed. The total amount allotted for Federal aid projects uncompleted in 1920-21 is \$1,403,493, and that for new Federal aid projects is \$4,000,000, making a total of \$5,403,493. From 44 to 50 per cent. of this amount is provided for from the State highway fund and



from the State highway bond fund and the balance is secured from the Federal aid appropriation.

### **Local Legislation**

In each county a board of three county commissioners serving four-year terms has jurisdiction over local roads. They may appoint a general overseer for all such roads or divide the county into districts and appoint a district overseer for each.

### **Bond Legislation**

In November, 1920, the people of the State voted a \$5,000,000 bond issue for State road improvement. Of this amount \$2,000,000 was offered for sale on June 30, 1921, and was later disposed of. Three million dollars will be offered for sale on June 30, 1922. One-half of the proceeds of both the issues is for the purpose of meeting Federal aid and one-half is allotted to the various counties for the construction and improvement of State roads within those counties, under the supervision of the State highway department.

When the county commissioners of any county shall deem it necessary to create a county indebtedness for road and bridge purposes, they may submit the proposition to a vote and, if a majority of the votes cast are in favor of the proposition, they may issue bonds of the county in the aggregate not to exceed the following: Counties of assessed valuation less than \$5,000,000, \$12 on each \$1,000; and counties of assessed valuation over \$5,000,000, \$6 on each \$1,000. These bonds shall bear interest not exceeding 10 per cent per annum, and shall be payable at the pleasure of the county after 10 years, but absolutely due and payable 20 years from the date of issue. An annual tax must be levied by the commissioners to pay the interest on the bonds and for their ultimate redemption. The commissioners must levy annually, after 10 years, such a tax upon all taxable property in the county as will create a yearly fund equal to 10 per cent of the whole amount of the bonds.

### **Convict Labor**

At the request of the board of county commissioners the warden of the State penitentiary shall detail such a number of prisoners to work on public roads as he shall deem proper. The additional cost of guarding and other expenses must be borne by the county.

### **Automobile Registration**

Motor vehicles are registered annually with the Secretary of State. The fee for passenger cars is one-half of 1 per cent of the original cost price to owners, f. o. b. factory, with a minimum

fee of \$5. A reduction of 50 per cent on this rate is allowed for cars purchased eight years previous to registration and a reduction of 30 per cent is allowed for cars purchased five years previous to the date of registration.

Registration fees for motor trucks are: 1 ton and less, \$10; 1 to 2 tons, \$17.50; 2 to 3 tons, \$25; 3 to 4 tons, \$37.50; 4 to 5 tons, \$50; for each additional ton or fraction thereof over 5 tons, \$25; for motor vehicles used in transportation of passengers for hire and which seat nine passengers, \$20, with an additional fee of \$1 for each additional seating capacity provided.

### Road Funds

State highway funds are obtained from the following sources:

Proceeds from a 1 mill State wide tax, estimated for 1922.....	\$1,578,256
Receipts from the Internal Improvement Fund.....	50,000
One-half the revenue derived from the registration of automobile vehicles .....	457,932
One-half the gasoline tax of one cent per gallon, amounting to about.....	275,000

In addition to this are the receipts from Federal aid from the sale of State highway bonds and from miscellaneous sources. The total receipts by the department for 1921 were \$4,089,534, and the total estimated receipts for 1922 is about \$11,000,000, including revenue from the bond issues.

Automobile and gasoline revenues and the receipts from fines and forfeitures are divided equally between the State highway department to be expended on improving and maintaining State roads, and the road fund of the various counties according to the collections from each county.

In addition to the State road money, the counties levy a tax for local road purposes which averaged in 1921 about 2.5 mills and which produced about \$3,700,000. This will be materially increased in 1922.

### Progress Report

During the year 1921 there were either completed or placed under contract 51 miles of concrete pavement; 58 miles of grading mountain roads; 61 miles of grading plains roads, and 149 miles of road surfacing either with gravel, rock or sand clay. The total number of miles of road for which improvements were either made or contracted for amounted to 319 miles in 1921, at a cost of about \$4,125,000. Approximately the same amount of money will be spent on new work in 1922, but due to lower prices this will cover in the neighborhood of 335 miles, distributed as follows: 45 miles concrete pavement; 60 miles of grading mountain roads; 70 miles of grading plains roads, and 160 miles of



surfacing. In addition to the amount above given, there will be spent approximately \$1,000,000 on bridge work during 1922.

### Maintenance

For the year 1921 there was allotted in the annual budget \$150,200 for maintenance of State highways and \$186,000 for assisting various counties in the State, both in the construction and maintenance of State routes in the various counties. Owing to the unprecedented disastrous floods of June, 1921, the total allotment was wiped out in a short time and the emergency nature of the expenditures renders it impracticable to determine just what portion was spent on maintenance and what portion on reconstruction. The counties themselves probably spent an equal amount to that furnished by the State on the maintenance of State roads within the respective counties.

During 1922 there will be maintained under State supervision 7,016 miles of State highways. Included in this mileage is 4,224 miles of road that will be constantly patrolled. There has been allotted for this work \$605,110 by the various counties to match an equal amount allotted by the State highway department, and in addition to these two sums, there has been allotted \$94,890 as a reserve maintenance fund in the highway department, making a total to be spent on maintenance of State highways during 1922 \$1,305,110.

### State Highway Officials

State Highway Engineer.—L. D. Blauvelt, Denver.

Advisory Board.—District No. 1, E. E. Sommers, Denver; District No. 2, William Weisner, Grand Junction; District No. 3, J. A. Clay, Durango; District No. 4, Geo. L. L. Gann, Vice-Chairman, Pueblo; District No. 5, Chas. B. Lansing, Colorado Springs; District No. 6, H. A. Edmonds, Chairman, Fort Collins; District No. 7, J. D. Blue, Jr., Sterling.

## CONNECTICUT

### State Highway Legislation

The State highway commissioner is appointed by the governor with the consent of the Senate and holds office for four years. He is empowered to enter any town in the State and to lay out and improve any of the legally established trunk line roads and certify the cost to the State comptroller for payment, providing such payments do not exceed appropriations made for the purpose by the legislature. He has authority to approve the application of the selectmen of any town for State aid, to select the highway to be improved with such aid, to make surveys, plans and specifications



therefor, to determine the character of the work, and to supervise the construction. He may reject any and all bids for highway construction, and where the cost is less than \$1,000 he may at his discretion permit the town to do the work. He must keep all State roads in repair and certify the cost to the comptroller. He is authorized to appoint a deputy commissioner, division engineers and such other assistants as he may deem necessary and fix their salaries.

Whenever any town desires to improve a public or State aid road with the aid of the State the selectmen of the town make application to the State highway commissioner for such aid, and the application is subject to his approval. The aid granted by the State is apportioned as follows: In towns having a taxable valuation of over \$1,250,000 the State pays three-fourths of the cost of roads constructed as State aid roads, and in towns having a valuation of \$1,250,000 or less the State pays seven-eighths of the cost of construction.

Under the 1919 law no sum exceeding in the aggregate \$10,000 excluding the amount expended on trunk lines, shall be expended in any one town in any one year on State aid road work with this exception: The commissioner may allot and expend sums in excess of this amount on State aid roads where there exists an unfinished section of State aid road in any town or towns, which section of road in the opinion of the highway commissioner should be completed in one operation. To finance such work, the highway commissioner may allot and expend sufficient money to complete such section, provided he can make an agreement with the town or towns in which the unfinished section or sections are located to have said town or towns pay their proportionate share of the cost of construction. The town or towns receiving the benefit thereof shall be excluded from participation in State aid appropriations until all other towns shall have had an opportunity to participate in future appropriations to an equal amount.

A trunk line system comprising the principal roads of the State, embracing 1,500 miles, is gradually being constructed and maintained entirely at the cost of the State. Of this system 994 miles have been improved. The State highway commissioner is authorized to lay out, widen and grade any highway in the State whenever he deems it necessary for the purpose of connecting with the trunk line highways. Towns are permitted to improve State aid roads with their own funds and to recover the State's proportion of the cost of the improvement under a subsequent appropriation by the State. The work must be done under the supervision of the State highway department and must not exceed an amount designated by the department.

The maintenance of trunk line roads is paid for entirely by the State, while the maintenance of State roads other than those on

the trunk lines is borne by the State and town in the ratio of three-fourths and one-fourth, respectively. All moneys received by the State from automobile licenses and fines are applied to road maintenance.

The law of 1915 directs the highway commissioner to erect and maintain uniform direction and danger signs on trunk line highways. It also provides that the highway commissioner may petition the public utilities commission for authority to eliminate dangerous conditions on these highways. This is a distinct departure from the previous policy of the State.

A law which placed under the jurisdiction of the highway department all trunk line highway bridges having a span greater than 25 feet, whether these bridges are located on improved sections of road or not, was passed in 1915, and amended in 1919 to include bridges on State aid roads. When bridges are between two towns or two counties, the State pays half of the cost and the two towns or counties the other half. When any lines of an electric street railway company cross such a bridge, the expense is divided one-third by the State, one-third by the railway company and one-third by the town or towns.

A law passed in 1919 provides that any highway or bridge or both not maintained wholly or in part by the State in any town having a grand list of less than five million dollars which shall have been damaged to an amount in excess of one hundred dollars by reason of the operation thereon of any commercial motor vehicle or vehicles having a carrying capacity of more than three tons, shall be repaired by the highway commissioner at the expense of the State. The selectmen of any such town, however, must certify to the State highway commissioner the location and extent of such injury and estimate the probable cost of repairing the damage. Upon receipt of such certification, if the statements are correct, the State highway commissioner shall cause the repairs to be made. In this connection, if the owner of any commercial vehicle desires to operate the same over any highway or bridge not maintained wholly or in part by the State, he may make application for such repairs as may be necessary for the accommodation of such vehicle, giving the estimated cost of such repairs. If the amount exceeds \$100.00, the selectmen may apply to the highway commissioner for assistance, and if public necessity or convenience requires, such repairs may be made by the highway commissioner and the cost apportioned between the State and the town.

The 1915 law makes the State responsible for damages to persons and property when caused by an imperfect condition of a State highway due to carelessness or neglect. Before the passage of this law the State could not be sued, and as the maintenance of trunk line highways was removed from the towns anyone injured



in person or property had no recourse at law. The 1915 law imposed upon the State highway department the obligation to keep trunk line highways sufficiently free from snow during the winter season to allow travel over them. The expense is borne by the State.

The law of 1919 also provides that the State may employ inmates of any penal institution, other than those serving a life sentence, in the construction of any highway or bridge under the supervision of said commissioner.

A law of 1917 provides for the State's participation in money allotted by the Federal government for the improvement of State trunk line highways. Under this law one section of concrete road and two sections of bituminous macadam already have been constructed and three other contracts are now in progress.

### **Local Legislation**

Local road work is under the board of selectmen of each town, selected annually. If they refuse or neglect to maintain the roads, the board of county commissioners may order the work done, when petitioned to do so. Funds for town roads are usually paid from the town budget tax. The State highway department has no authority over town roads.

### **Bond Legislation**

No local bonds are issued, but from time to time the State has issued bonds for roads and other purposes. In 1907 and again in 1911, when deficits occurred in the State treasury, a total of \$7,000,000 of State bonds was issued. The larger portion of the receipts was appropriated to pay the State's portion of State aid and trunk line roads.

### **Automobile Registration**

Motor vehicles are registered annually with the commissioner of motor vehicles at Hartford. For passenger cars the rate is 8c. per cubic inch piston displacement; for steam and electric vehicles, 75c. per h. p.; for commercial vehicles equipped with pneumatic tires, \$22.50 for one ton or less of carrying capacity; 1½ tons, \$30; 2 tons, \$37.50; for all other commercial vehicles except those carrying passengers, the rate is as follows: 1 ton or less of carrying capacity, \$30; 1½ tons, \$40; 2 tons, \$50; 2½ tons, \$60; 3 tons, \$70; 3½ tons, \$90; 4 tons, \$137.50; 4½ tons, \$162.50; 5 tons, \$187.50; 5½ tons, \$218.75; 6 tons, \$250; over 6 tons, \$250, plus \$100 for each additional ton. For public service vehicles there is a flat rate which varies with the seating capacity and an additional rate for each additional seat.



### Road Funds

The legislature of 1919 changed the fiscal year so that it would end on June 30 instead of September 30, as heretofore.

The gross expenditures for the highway department for the fiscal year ended June 30, 1921, were \$7,127,960.84. The purposes to which these funds were applied and the amounts expended for the various purposes are as follows: State-aid construction, \$952,543.13; trunk-line construction, \$413,021.17; Federal aid, \$844,959.86; trunk-line bridges, \$871,861.62; town roads and bridges, \$2,195.39; toll bridges and ferries, \$79,994.79; trunk-line reconstruction, \$1,116,609.89; State-aid repairs and reconstruction, \$397,801.33; Thames River bridge, \$2,318.32; Niantic bridge, \$29,395.46; dangerous trunk lines, \$13,284.93; trunk-line maintenance and reconstruction, \$2,284,755.87; office and clerical (including equipping new office), \$44,365.92; deputies and engineering, \$152,662.68; commissioner's salary, auto and traveling, \$12,190.48.

The revenues from the automobile registration licenses, etc., for the year amounted to \$2,126,772.88, all of which was transferred to the State highway department for the repair, maintenance and reconstruction of trunk line highways.

Appropriations for the two fiscal years ending June 30, 1923, are: Federal aid, \$1,000,000; trunk line, \$900,000; Grosvenor-dale road (special), \$60,000; incompleted intervals, \$600,000; State-aid repairs, \$500,000; dangerous trunk lines, \$100,000; trunk-line bridges, \$550,000; deputies and engineers, \$400,000; office and clerical, \$50,000; commissioner's auto, \$8,500; commissioner's traveling, \$2,000; commissioner's salary, \$16,000. In addition, receipts from automobiles estimated at \$2,500,000 per year.

### Progress Report

Since the last report, printed in the 1921 Highways Green Book, the department has let many important construction and reconstruction contracts. The more important of these are listed as follows:

<i>Town</i>	<i>Length in feet</i>	<i>Cost</i>
Bethel Danbury.....	6,972	\$72,000.56
Hamden.....	24,330	138,173.72
Hamden.....	12,524	99,437.22
Stafford.....	4,750	78,156.93
Orange.....	12,450	111,770.52
Columbia-Hebron.....	11,500	93,212.07
Branford.....	23,000	165,191.54
West Hartford.....	6,357	41,950.18
Killingworth-Haddam.....	33,780	142,414.32
Barkhamsted-Winchester.....	27,370	50,000.00
New Milford.....	4,863	39,400.00
Old Lyme-East Lyme.....	21,900	99,000.00
Norwich-Preston.....	22,500	130,000.00
Burlington.....	16,270	86,000.00
Killingly.....	20,600	150,000.00
Shelton.....	19,250	90,814.21

Following is a tabulation of the road mileage completed under various types for the fiscal term ended June 30, 1921:

	<i>Construction</i>	<i>Reconstruction</i>
Graded.....	1.29	
Gravel.....	13.37	3.59
Stone surface.....	.86	
Macadam.....	20.69	1.75
Bituminous macadam.....	10.41	6.62
Bituminous concrete.....	.02	1.91
Concrete.....	7.65	.34

### Maintenance

At the present time the department has 1,612.34 miles of improved road under its care. The State has a well organized system of patrolling the improved highways. This is under the direct charge of a superintendent of repairs. The actual work is carried on by 11 supervisors, 660 laborers, 161 trucks and some teams. The State also has a complete equipment of road rollers, scrapers, hones and other machinery of a kindred nature.

### State Highway Officials

Charles J. Bennett, highway commissioner; Richard L. Saunders, deputy; W. L. Ulrich, superintendent of repairs; C. G. Nichols, chief clerk.

Revised by C. G. Nichols, chief clerk.

## DELAWARE

### State Highway Legislation

The first county-aid law was enacted in 1903. It provided money aid to the amount of \$10,000 per annum for each of the three counties, to be expended with an equal amount raised by the counties under a State highway commissioner for each county.

From 1903 to 1917 about 180 miles of more or less disconnected road were constructed under the county-aid system. In addition to the money appropriated for each county, \$1,000 was appropriated by the general assembly to pay the salary of the State highway commissioner for New Castle county, the county-aid money in the other two counties being expended under the direction of the county engineers.

The legislature of 1917 created a State highway department and provided for the construction and maintenance of a system of State highways entirely at the expense of the State. This system is to be paid for from the funds derived from the State bond issue, proceeds from the automobile licenses, and the State income tax.



The State highway commission is composed of the Secretary of State and four members appointed by the governor, who serve without compensation, and not more than two members belonging to the same political party. One member must be a resident of Wilmington and one from each of the three counties. The administrative head of the department is the chief engineer, appointed by the commission. He must be a civil engineer, not less than 30 years of age, shall have been in active service of his profession for 10 years, and shall have had responsible charge of engineering work for at least 5 years and shall be qualified to design and direct work. He may receive a salary of \$7,500 per annum.

New Castle county still retains the office of the State highway commissioner who has charge of the construction of permanent roads, constructed by county funds as well as the roads constructed with money available from the 1903 county aid law. The State highway department has taken up its entire available allotment of Federal aid.

The legislature of 1919 provided for the building of State aid roads, connecting with the State highway system, to be constructed by the State highway department, the cost borne equally by the State and county. These roads will become a part of the State system on their completion.

### Local Road Legislation

Jurisdiction over local roads is vested in the county courts called the levy courts, which appoint the county road engineers. In Sussex county there is also a bond issue commission which has jurisdiction over the spending of \$2,000,000 of road bonds. Approximately \$900,000 was expended by the three counties during 1921 for highway purposes. It is expected that approximately an equal amount will be expended in 1922.

### Bond Legislation

The State may issue 40-year, 4½ per cent. bonds, subject to call after the first year. The State treasurer is authorized to create a sinking fund and to deposit in it 2½ per cent per annum of the total bonds outstanding.

Up to this time most of the funds with which the roads have been permanently improved in the various counties have been derived from county bond issues. Kent county issued \$30,000 in 1913 and New Castle \$1,250,000. The general assembly of 1917 authorized \$100,000 for Kent county, \$600,000 for New Castle, and \$1,000,000 for Sussex.

In 1919 the general assembly authorized New Castle county to issue \$700,000 of highway bonds. At a special session in 1920 Kent county was authorized to issue highway bonds to the amount

of \$1,000,000. General assembly, 1921, authorized an additional bond issue for Sussex county for highway purposes of \$1,000,000.

In New Castle and Sussex the bonds may bear  $4\frac{1}{2}$  per cent interest, in Kent 5 per cent. They are of the deferred serial type, the first payment falling due 10 years from the date of issue, and the last payment from 39 to 49 years. They may be issued, however, subject to call after 5 years.

### **Convict Labor**

In the counties of Kent and Sussex vagrants and minor criminals may be sentenced to hard labor on county roads. In New Castle county the levy court is empowered to employ all able-bodied convicts on public roads.

### **Automobile Registration**

Automobiles are registered with the Secretary of State. The fee for registration is \$2 for each 500 pounds or fraction thereof.

### **Road Funds**

From the automobile fund there is first deducted sufficient money to pay the expenses of the highway department and for the maintenance of State roads. The remainder may be used for the establishment of a sinking fund and for the payment of interest for any State highway bonds which may be issued.

In addition to this revenue, all money above \$250,000 received from the State income tax may be used for the construction of State roads. Funds for State-aid roads may be taken from bond-issue funds when issued, the State and the counties each contributing 50 per cent.

There have been issued by the State, from the automobile registration funds, State highway bonds to the amount of \$3,929,000.

During 1921 there was expended by and under the supervision of the State highway department State funds from bond issues raised from automobile funds to the amount of \$2,356,000; Federal aid funds to the amount of \$244,314, and of the private funds of Mr. T. Coleman DuPont \$1,000,000.

There is available for the year 1922 from the private fund donated by Mr. T. Coleman DuPont \$300,000.

County bond issues available for State aid \$2,300,000 and Federal aid fund of \$365,600. State funds will be available to the amount of \$1,400,000.

### **Progress Report**

Since its organization in 1917 the State highway department has contracted for the construction of 165 miles of hard surfaced



roads. At the close of the season of 1921, 154 miles of this total were completed. Of the mileage contracted, 134 miles were of cement concrete, the remainder being of brick and bituminous macadam. There was constructed during the year 1921 by the State highway department 53 miles of cement-concrete road, and four miles of bituminous macadam. It is expected that in 1922 there will be constructed approximately 60 miles of cement-concrete road.

It is expected that the main north and south system will be completed during the season of 1922 and the east and west systems well under way.

The 1922 program calls for the letting of approximately 60 miles of new construction.

In addition to the mileage already mentioned, the State system includes 28 miles of concrete road built by Mr. T. Coleman DuPont and presented by him to the State, also 6 miles presented in like manner by Mr. Pierre DuPont.

The total mileage of rural highways in the State of Delaware is 3,796. There are included in the State and State aid system 198 miles of improved and completed roads.

### Maintenance

During the year 1921, 130 miles of State highway were maintained at an expense of \$318,000. There will be under maintenance during the year 1922 approximately 198 miles. The funds for the maintenance of State roads are obtained from the automobile license fees. On the State aid roads the counties provide for the maintenance to the extent of \$100 per mile per year.

### State Highway Officials

State Highway Department.—Alden R. Benson, chairman; Joseph E. Holland, Walter O. Hoffecker, Newton L. Grubb, T. Coleman DuPont, C. Douglas Buck, chief engineer; I. Paul Jones, secretary.

County Officials.—Charles E. Grubb, county engineer and State highway commissioner for New Castle county; T. Marvel Gooden, county engineer for Kent county; R. C. Hill, Jr., county highway engineer and executive officer of the commission, and engineer for Sussex county.

Revised by W. W. Mack, assistant engineer.

### DISTRICT OF COLUMBIA

The three commissioners appointed by the President to administer the affairs of the District of Columbia annually forward to Congress through the Secretary of the Treasury estimates of pro-

posed expenditures for each fiscal year ending June 30. Appropriations providing for the expenses of the government of the District of Columbia are paid in the proportions of 40 per cent from the Treasury of the United States and 60 per cent from the revenues of the District of Columbia. Road and street affairs are administered by one of the commissioners, who is an army engineer.

### Automobile Registration

Motor vehicles are annually registered with the collector of taxes, the rates being as follows: 24 h. p. or less, \$3; 24 to 30 h. p., \$5; more than 30 h. p., \$10; motorcycles, \$2. This is in addition to the regular property tax.

### Progress Report

The mileage of streets and roads in the District of Columbia on June 30, 1915, June 30, 1916, and June 30, 1920, was:

	1916 Miles	1919 Miles	1920 Miles	1921 Miles
Asphalt .....	159.42	167.78	172.82	179.98
Asphalt block .....	30.59	21.75	32.02	31.74
Granite block .....	23.93	22.03	21.13	19.59
Cobble .....	3.31	3.01	2.73	1.56
Vitrified block .....	1.34	1.04	1.04	1.04
Bituminous concrete .....	7.26	7.26	7.26	7.26
Cement concrete .....	3.75	6.71	11.82	13.45
Bituminous macadam .....	4.36	123.76		
Waterbound macadam .....	118.42		125.29	120.85
Gravel and dirt roads .....	161.31	153.49	147.72	148.88
Durax block .....		.30	.30	.57
Total .....	513.69	517.13	522.13	524.92

### Road Funds

The following amounts have been appropriated for road and street work in the District of Columbia for the fiscal year ending June 30, 1922: Street improvements (\$144,840), repairs to streets, avenues and alleys, \$575,000; repairs to suburban roads, \$250,000; total, \$969,840.

### Highway Officials

Engineer commissioner in charge of public work, Col. C. Keller, U. S. A.; assistant to the engineer commissioner, in charge of surface division, Major F. S. Besson, U. S. A.; engineer of highways, C. B. Hunt.

Revised by C. Keller, Col. Corps of Engineers, U. S. A., Engineer Commissioner, D. C.



## FLORIDA

### State Highway Legislation

The State road department, created by the legislature of 1915, consists of five members, one representing the State at large and one from each of the four congressional districts. They are appointed for terms of four years.

By the law of 1919, the chairman is the executive officer of the commission and receives a salary of \$4,200 per annum. The other members are paid \$600 per annum each. The commission employs a secretary at a salary of not more than \$2,000 per annum.

The department is authorized to employ a State highway engineer. The title "State highway engineer" succeeds that of "State road commissioner" provided for in the original law creating the department.

The department is authorized to enter into contracts and to make such rules and regulations as may be necessary for the construction and maintenance of such roads and bridges as may be by law or by resolution of any board of county commissioners or board of bond trustees of any county or subdivision of any county placed under its supervision and control. The department may have work done by contract or by convict or free labor and may purchase such equipment and supplies as may be necessary.

The department is authorized to designate certain roads as State roads and other roads as State-aid roads. State roads are to be constructed and maintained with State funds or with State and Federal funds. When such roads are so designated they become State property and the State is given the right to acquire the rights of way by purchase or condemnation. State-aid roads are to be constructed with Federal and State or county funds under the supervision and control of the State road department. The counties pay not less than one-half of the cost of construction and maintenance, the balance being paid by the State.

### Local Legislation

Jurisdiction over local roads is vested in boards of county commissioners, five of whom are elected for each county, one for each district. These commissioners appoint three road trustees annually for each road district under whose direction road work is carried on. Special road and bridge districts may be created by election, but special taxes are levied and collected by the county boards. When the electors vote to make their road districts special taxing districts they elect at the same time three trustees to supervise the work. County road taxes may be levied by boards of commissioners at rates of not less than 3 nor more

than 8 mills on the dollar. Fifty per cent of such taxes collected in cities and towns must be turned over to municipal authorities for street improvements. Local road taxes may be worked out.

### Bond Legislation

Upon petition of 25 per cent or more of the registered voters who are freeholders residing in any territory embraced wholly or in part in one or more road districts of a county, requesting that a special road and bridge district for the purpose of improving roads and bridges be created, and that a special tax or that bonds be issued, the boards of county commissioners are required to order an election thereon. If agreed to by a majority vote of freeholders the board of county commissioners is required to issue necessary bonds and levy an annual tax on the district to pay the interest and create a sinking fund for the redemption of the bonds.

### Convict Labor

The leasing of the State convicts to corporations, firms, or individuals, was abolished by the laws enacted in 1919.

All able-bodied State convicts, except 75 to be retained on the State farm, are required to work on the public roads of the State under the supervision and control of the State road department.

The county commissioners of the various counties may employ county jail prisoners under sentence of crimes upon the public roads and bridges of the counties or they may hire prisoners to other counties for road work, or in the event that no county will hire them they may be leased to contractors.

### Automobile Registration

The registration of automobiles is made annually with the State comptroller. The rates are as follows:

Automobiles for private use, 50c. per 100 pounds; passenger automobiles operated for hire, not exceeding seven passenger capacity, 75c. per 100 pounds, plus \$5 per passenger. Passenger automobiles operated for hire carrying 7 to 16 passengers, 75c. per 100 pounds, plus \$7.50 for each passenger. Passenger automobiles operated for hire carrying more than 16 passengers, 75c. per 100 pounds, plus \$10 per passenger seating capacity. Motor trucks for private use equipped with pneumatic tires, 75c. per 100 pounds; if equipped with solid tires, the rate is \$1.12 per 100 pounds; motor trucks used for hire equipped with pneumatic tires, \$1.50 per 100 pounds; if equipped with solid tires the rate is \$2.25 per 100 pounds gross weight including factory rated load capacity; passenger automobiles for hire operating between depots



and hotels, 50c. per 100 pounds, plus \$5 per passenger according to seating capacity. The fees for trailers range from 75c. to \$2.25 per 100 pounds depending on the weight. Motorcycles, \$5; motorcycle side cars, \$3.

### **Road Funds**

For the support of the State road department and for State aid in the construction and maintenance of State roads the legislature of 1921 passed a law authorizing a levy of a 1 mill tax on each \$1 of assessed valuation in the State for the years 1921 and 1922; a motor vehicle license law and a law imposing a tax of 1c. per gallon on gasoline.

The receipts from these various sources during 1922 is expected to be about as follows: Gasoline inspection tax, \$80,000; 1 mill property tax, \$475,000; motor vehicle license tax, \$800,000; 1c. per gallon on gasoline, \$600,000.

### **Progress Report**

During 1921 comparatively little paving was done but the grading of approximately 125 miles of road was completed. Contracts for hard surfacing of approximately 100 miles of road were let. The remainder of the graded roads are being surfaced with sand-clay and top soil.

The legislature of 1921 authorized counties and road and bridge districts to aid the State road department in the construction of State or State aid roads. Under this law counties are joining with the department in the construction of approximately 219 miles of road, a considerable part of which is expected to be completed during 1922.

### **State Highway Officials**

State Road Department.—H. B. Philips, chairman; J. D. Smith, Marianna; W. J. Hillman, Live Oak; W. W. Clark, Wall Springs; I. E. Schilling, Miami; Wm. F. Cocke, State highway engineer; James Austin Mortland, bridge engineer; Headquarters, Tallahassee, Florida.

Revised by H. B. Philips, chairman of commission.

## **GEORGIA**

### **State Highway Legislation**

Highway legislation in Georgia originally placed all road authority in the counties of the State, which now number 160. In 1916, a State highway department was created, unsupported by State funds, whose sole function was to handle the Federal-aid allotments to Georgia by acting as agent for the counties which furnished the money to match Federal aid. In the 1919 session

of the general assembly a newly constituted State highway department, well supported from motor vehicle licenses and broadly empowered, was created having in prospect the expenditure of \$2,000,000 income from the motor vehicle licenses beginning with 1920, in addition to administering the Federal aid allotments to Georgia.

The State highway department embraces a State highway board of three men appointed by the governor for terms of six years with per diem compensation; a State highway engineer selected by the board; and a staff fixed by the board, but filled by direct employment of the engineer.

Georgia has participated in Federal-aid allotments since the passage of the act in 1916 to the extent of nearly \$7,000,000 a larger sum being furnished by many counties of the State wherein 231 separate projects are located on the main highways. Seventy-six projects are now under construction representing about \$4,500,000 total expenditure. Total allotment to counties matched by county money aggregates nearly \$10,000,000 of which about \$2,000,000 is given to important bridge construction over the large rivers of the State. The new State law does not necessarily change the method of administration of Federal aid funds, but permits combination of both Federal and State aid in the discretion of the board. Legislative changes in 1921 requires the board to expend State funds in counties on basis of State road mileage in each county; establishes the State system at 5,500 miles and requires State maintenance of the State roads.

### Local Legislation

Administration of road and bridge affairs in the counties is vested either in an official, termed the "ordinary," or in a board of commissioners of roads and revenues, the boards consisting of from one to eight elective members, with terms ranging from two to six years. Because of the number of special acts and forms or procedure optional with county authorities a uniform organization of local road forces does not prevail throughout the State.

The counties levy direct property taxes for roads and bridges and use also a poll tax for roads. The figures vary in different counties. The felony and misdemeanor convicts are used as labor, being distributed to the counties by the State prison commission and entirely maintained at county expense. No system of accurate report of annual expenditure on roads from these sources is kept. It is commonly estimated that Georgia counties are now expending from county current funds not less than \$4,000,000 on its total public road mileage of 83,000 miles.



### **Bond Legislation**

Under the impetus of Federal aid, and in the hope that such aid will be permanent and annually increasing, many counties issued substantial amounts of road bonds during 1919. The aggregate so issued in 44 counties reached \$16,000,000. Expenditure of this bond money is made in a number of cases dependent on the receipt of Federal aid on a 50-50 basis, and the sale of the bonds is to be in such amount from time to time as will meet the Federal aid received. Some of this bond money is now pledged against the Federal aid projects previously mentioned. It is impossible to say how much of this will be spent at an early date, owing to local control and limitation of the terms of issue. It is probably assured, however, that at least \$2,600,000 of it will be used to meet the \$2,600,000 of Federal aid allotted to Georgia for 1922 and 1923. And it is probable that a much larger amount will be contracted owing to the eagerness of the counties for paved roads. The new law carries a promise of reimbursement of the cost of State roads to the counties, but postpones the repayment until the 5,500 miles embraced in the State system of roads is completed.

### **Convict Labor**

Georgia has used convict labor for a number of years distributed to and supported by the counties. The number of available convicts diminished during the war period, but has increased again during 1920 and 1921. The number of counties has increased, so that 5,000 convicts divided among 160 counties yields small working units in many of the counties. The overhead costs plus the increased cost of feeding, guarding and clothing them are becoming burdensome in some cases. Some counties are leasing their quotas to other counties under this pressure, but there is no widespread movement to give up the system.

### **Automobile Registration**

The growth in automobile registration has been rapid. The record for 1918 was about 95,000; that for 1919 exceeded 120,000; for 1920 it exceeded 150,000. Rates, 75 cents per h. p. for passenger cars, and \$15 per ton capacity for trucks up to 4-ton, the rates rising rapidly for larger capacities and reaching \$1,125 for trucks of 7 tons and over. The rates are designed to discourage the use of very heavy capacities. A shrinkage of about \$200,000 in revenue was shown in 1921.

### **State Road Funds**

During the year 1921 approximately \$1,800,000 was derived from the automobile registration fees, and it is estimated that the same amount will be available during 1922.

### Progress Report

Lacking any system of reports to the State it is impossible to give any reliable statement of annual progress. Counties have been active in repairs and new construction of the prevailing sand-clay and top-soil roads. The repair costs have mounted heavily with the rapid growth of automobile and truck service. It is from this main cause that the sentiment for improved roads has sprung which crystallized in the legislation for State roads recently enacted. Further legislation is contemplated to remove constitutional restrictions and provide a direct issue of State road bonds for more rapid construction of the State system. A campaign for the issue of \$75,000,000 at the rate of \$7,500,000 per year is now actively in progress.

#### SUMMARY OF PROJECTS CORRECTED TO DECEMBER 22, 1921

There have been completed 155 projects in 85 counties and there are under construction 76 projects in 73 counties. They embrace:

Paved roads. . . . . 277.41 miles with 184.71 miles completed.  
 Sand clay . . . . . 974.06 miles with 500.43 miles completed.  
 Graded. . . . . 62.12 miles with 35.60 miles completed.  
 52 bridges . . . . . with 41. miles completed.

Projects under construction contain more than 450 miles of completed work. Total sums invested in the above about \$19,000,000; from U. S. funds, \$7,500,000; from counties, \$9,000,000; from State, \$2,500,000.

#### State Highway Officials

State Highway Board.—John N. Holder, Jefferson, Ga., chairman; R. C. Neely, Waynesboro; Stanley S. Bennete, Quitman; State Highway Engineer, W. R. Neel; Bridge Engineer, Searcy B. Slack; Chief Field Engineer, B. C. Milner; Secretary-Treasurer, H. G. Spahr; Attorney of Board, G. H. Howard.

Headquarters: Peachtree Building, Atlanta, Georgia.

### IDAHO

#### State Highway Legislation

The 1919 legislature passed a bill which reorganizes all State departments and institutions. Under this bill the State highway commission was abolished and its duties assumed by the commissioner of public works.

Under the general supervision of the commissioner of public works, there is a director of highways who shall be a civil engi-



neer of not less than 5 years' experience in road building. He is appointed by the governor.

The department of public works has power to lay out, build, construct and maintain State highways and bridges at any place within the State; to purchase, condemn or otherwise acquire the necessary lands for right of way, etc., for State highways; to cooperate with and receive aid from the Federal government, and to receive and expend donations from other sources for the construction and improvement of any State highway; to contract jointly with counties and highway and good-road districts for the improvement of State highways; to prescribe and enforce rules and regulations affecting State highways; to investigate methods of road construction and to establish standards of construction and maintenance of highways adapted to different sections of the State; to keep records of all State highways, including surveys, plans, specifications and estimates, and, so far as practicable, of all highways in the State, and for that purpose to demand and to receive reports and copies of records from local road officials; to advise, assist and cooperate with local officials upon request in the planning, building, and constructing of local roads.

Construction work on State highways, of which about 3,700 miles have been laid out, is carried on by the State in conjunction with the Federal government, counties or highway districts. State funds are used to pay one-third the cost of construction and the counties or highway districts, and when possible Federal funds, the balance.

All contracts are let by the commissioner of public works and the work is done under the supervision of the director of highways. Upon completion the roads are maintained by and at the expense of the State.

Funds with which to cooperate with the Federal government in 1921-2 are raised by a State highway bond issue of \$2,000,000 and by bond issues voted by county commissioners and commissioners of highway districts.

### Local Legislation

Jurisdiction of roads is vested in boards of county commissioners, or boards of highway commissioners of highway districts, who usually appoint a director of highways for each district. Property taxes may be assessed at rates not to exceed \$1 on each \$100 of assessed valuation. A poll tax, payable in cash, is also levied at a rate of \$4 per capita.

### Bond Legislation

There are two classes of road districts authorized by law to issue bonds. For details see Highways Green Book for 1921, page 91.

### **Convict Labor Laws**

The director of highways is authorized to make requisition upon the warden of the State penitentiary for convicts for road labor, subject to the rules and regulations of the board of prison commissioners. The warden and prison commission assign such prisoners as they deem physically able and at the same time reasonably safe to work on the State highways, and prisoners are to be paid \$5 monthly for their services.

### **Automobile Registration**

The law provides for annual registration with the Secretary of State through the assessors of the various counties. The schedule of fees is as follows: 2,000 pounds or less, \$15; more than 2,000 pounds to and not exceeding 3,000 pounds, \$20, plus \$10 for each 1,000 pounds.

The counties retain 75 per cent of the fees to pay the interest on any road bonds which may be outstanding to be used on the county roads, and the remaining 25 per cent is forwarded to the State treasurer, who deducts 10 per cent of the amount to pay the interest on outstanding State highway bonds, and the balance is used for State highway maintenance.

### **State Road Funds**

The State has voted additional highway bonds in the sum of \$2,000,000. This, together with 9/10-mill State-wide tax, which will produce approximately \$450,000 per annum, and the income from motor vehicle licenses, \$150,000, constitutes the available fund for the State's share of highway construction and maintenance.

### **Progress Report**

During 1921 the total mileage of State highways completed was 517 miles of which 23 miles were bitulithic, 8.5 cement-concrete and 156 earth and 329.5 gravel or crushed rock surfaced. It is expected that the greater portion of the earth roads will be rock or gravel surfaced in 1922. The total mileage to be maintained by the State in 1922 will be approximately 1,500 miles.

### **State Highway Officials**

Commissioner of public works, Wm. J. Hall; director of highways, DeWitt P. Olson; headquarters, Boise.

Revised by D. P. Olson, director of highways, department of public works.



## ILLINOIS

### State Highway Legislation

Supervision over road affairs is vested in the division of highways of the department of public works and buildings. The division of highways is administered by a superintendent of highways and a chief highway engineer. The superintendent of highways, who is appointed by the governor with the advice and consent of the Senate, receives a salary of \$6,000 per annum. The chief highway engineer, who is appointed by the director of the department of public works and buildings with the advice and consent of the governor, receives a salary of \$7,000 per annum. Subordinate employes, classed as engineers, draftsmen, surveyors, agents, superintendents of expert help, foremen, repair men and laborers necessary in construction, maintenance and repair of State highways, are employed without reference to the State civil service act. Those employes who come under the classification of bookkeepers, stenographers and clerical forces are subject to State civil service regulations.

The department of public works and buildings has complete control over all Federal aid and State funds appropriated for road construction, and has the right to prescribe rules and regulations relative to the duties of its employes and of county superintendents of highways.

There are two systems of roads to which the State extends aid, namely:

First, State highways, comprising about 4,800 miles, which are being built and maintained entirely at the expense and under the direction of the State out of the \$60,000,000 bond issue and Federal aid funds allotted to Illinois. The department of public works and buildings prepares plans and specifications, determines the type, awards contracts, purchases machinery and materials where necessary, and, in fact, does everything that is required for the proper expenditure of the funds in the construction and maintenance of the system.

Second, State-aid roads, comprising about 11,200 miles, selected by the State and local authorities and constructed on a fifty-fifty basis by the State and counties. These roads are constructed and maintained under the supervision of the State from plans, specifications and estimates prepared by the State and approved by county boards. Types of surfacing on the State-aid roads are specified by county officials subject to State approval, but in order to encourage the selection of the more durable types of improvement the State agrees to pay 100 per cent of the cost of maintenance of the more durable types, such as cement concrete, bituminous concrete, brick, or other hard surfaced types.

The State pays one-half the cost of maintenance where the road is built with gravel or macadam; but pays no portion of the cost of an improved earth road. If a State-aid road is not properly maintained by the county, future allotments of State aid may be withheld until the road is properly maintained.

Practically no State-aid work was undertaken during 1919, 1920 or 1921, as all State forces and funds were concentrated during that period on the State system.

The department may undertake and supervise local construction to which no State money is applied when requested by local officials to do so, and upon request it is required to furnish plans, specifications and estimates of proposed improvements initiated by local officials.

**Federal Cooperation.**—The original Federal aid system, described below and consisting of approximately 780 miles, which was selected by the State highway commission as the system of Federal aid roads in Illinois, upon request of the office of public roads shortly after the passage of the Federal post roads act in 1916, is practically completed. The few sections which were uncompleted at the close of the 1921 construction season will be finished early in 1922.

Lincoln Highway, extending across the northern part of the State from Chicago to Fulton, Illinois.

Dixie Highway, extending south from Chicago Heights to Danville, Illinois.

Chicago-East St. Louis road, which connects Joliet, LaSalle, Peoria and Springfield with Chicago on the north and St. Louis via East St. Louis on the south.

National Old Trails Road, extending east from East St. Louis to the Indiana State Line at a point near Terre Haute.

Chicago-Wisconsin Line road, running from Chicago through Waukegan, Illinois, to the Wisconsin line.

An act was passed at the last session of the legislature providing that the department may, at its option, take over for maintenance, in addition to the completed trunk line roads, the unimproved State highways which are located on the State highways system.

### **Local Road Legislation**

With the exception of those roads which are taken over by the department for maintenance, in accordance with the provisions of the State highways act, all roads in the State are under the jurisdiction of township or district commissioners and the county superintendents of highways.

Each county has a county superintendent of highways, appointed by the county board after a competitive examination for the position, held by the State highway authorities. No part of



the State road and bridge fund may be apportioned to a county until it has appointed such a superintendent. The county superintendent is regarded as a deputy to the chief highway engineer. His term of office is six years, or until his successor is duly appointed and qualified. At the expiration of the six-year term, the person holding the position shall be eligible for reappointment without re-submission of his name by the county board and without further examination, provided such person shall be certified by the department as eligible for the position.

The county highway superintendent prepares the plans, specifications and estimates for all county bridges, subject to their final approval by the State highway authorities, supervises the construction and maintenance of all roads and bridges under exclusive county control or joint county and town or district control and advises the town or district highway officials on the maintenance and improvement of roads and bridges, and supervises the maintenance of State-aid roads in the county under the direction of the State highway authorities.

The control of local roads is exercised in two ways. In counties not under township organization, the county boards divide the territory into road districts, which are the local administrative units for highway purposes exclusively. In counties under township organization the several towns have authority over the roads. In either case the roads are in charge of a single highway commissioner in each township or road district. The local road tax of a town or district is determined by its commissioner annually. Any contract for construction, machinery or materials exceeding \$200 must be approved by the county highway superintendent.

There is an annual highway poll tax of \$1 to \$3 in each township or road district, payable to its treasurer by every able-bodied male resident, unless this form of taxation for local roads is abolished by vote of the electors of the town or district. The property tax levied by township commissioners for local highway purposes must not exceed 66 cents on each \$100 valuation. This tax yields more than \$14,000,000 annually and is used for the construction and maintenance of township roads. An additional tax of 13½ cents per \$100 for damage incident to the laying out of new roads, relocation and drainage may be levied. Not less than \$3 nor more than \$5 per mile per annum of the road funds of a township or road district must be used for dragging earth roads.

### Bond Legislation

The \$60,000,000 State bond issue voted by the people at the general election in November, 1918, bears interest at the rate of 4 per cent per annum. The bonds are of the serial type, payable

within 20 years, the interest and principal being paid from the proceeds derived from the motor vehicle fund; or, if that is not sufficient, from a State-wide tax. These bonds are to be issued as needed. The first issue (\$5,000,000) was sold in October, 1921.

### **Convict Labor Laws**

Prior to 1915, convicts were not worked outside prisons except in quarries getting out rock for State use. Crushed rock and other road material produced by convict labor is furnished free at the penitentiary, where prepared, to the State highway commission for permanent road improvements. In 1915 convicts were worked on local roads on requisition from town highway commissioners, a charge of 50 cents per man per day being made for board. Three or four convict camps were worked and about 25 miles of macadam road constructed by them.

### **Automobile Registration**

Motor vehicles are registered with the Secretary of State. The fees are as follows: passenger cars carrying not to exceed 7 persons, 25 h.p. and less, \$8.00; 25 to 35 h.p., \$12; 35 to 50 h.p., \$20; over 50 h.p., \$25; motor bicycles, \$4; electrics, \$12; motor vehicles carrying more than 7 passengers and motor trucks pulling or carrying freight, the gross weight of which amounts to 5,000 pounds or less, including the weight of the vehicle and maximum load, \$12; 5,000 to 12,000 pounds, \$22.50; 12,000 to 15,000 pounds, \$35; 15,000 and over, \$60; tractors and traction engines, \$25. Dealers' and manufacturers' license fees amount to \$20 for each set of duplicate tags.

Weight.—The weight of motor vehicles is limited to 16,000 pounds per axle or 800 pounds per inch of the average width of tire in actual contact with road surface. The gross weight, including the weight of the vehicle and maximum load of any self-propelled vehicle, shall not exceed 24,000 pounds; and the gross weight, including the weight of the vehicle and maximum load of any trailer or semi-trailer vehicle pulled or towed by a motor vehicle, shall not exceed 32,000 pounds. The gross load may be increased, under the provisions of the law, to 50 per cent on special permits in cities having a population of more than 20,000.

### **State Road Funds**

There was expended by the State in 1921 for highways built under the supervision of the State the sum of approximately \$16,000,000, derived from Federal and State funds. The sum of approximately \$35,000,000 is available for construction in 1922, and the sum of \$2,500,000 for maintenance. The State is now



maintaining about 1,586 miles of concrete and brick surfaced roads.

### **Progress Report**

During 1921, 402 miles of paved highways were completed, and 565 miles carried over for completion in 1922.

Research work carried out in connection with the Bates experimental road, which has been described in various engineering periodicals (and which was started in 1920 and completed in 1921) has led to important modifications in pavement designs used by the division of highways. It is believed that the results of these scientific investigations have not only made possible much better construction, but at a decided reduction in first cost. Auxiliary investigations, particularly with reference to the curing of concrete pavements, bid fair to result in better cured pavements and at lower costs than have heretofore applied.

Construction Program for 1922.—The 1922 program calls for the construction of approximately 1,100 miles of pavement, more than 300 miles of heavy grading, and 200 large bridges.

### **State Highway Officials**

Department of Public Works and Buildings: C. R. Miller, director; Don Garrison, assistant director. Office at Springfield.

Division of Highways: Frank T. Sheets, superintendent of highways; Clifford Older, chief highway engineer. Board of highway advisors: Richard R. Meents, chairman, Ashkum; Arthur R. Hall, Danville; Charles M. Hays, Chicago; Francis R. Woeffe and Joseph M. Page, Jerseyville.

Revised by Clifford Older.

## **INDIANA**

### **State Highway Legislation**

The State highway commission is composed of four members appointed by the governor for terms of one to four years, the term of one commissioner expiring each year. Each commissioner receives a salary of \$10 per day for the time actually employed. The commission appoints a director, who is the executive officer of the commission. The director appoints a chief engineer, who is in charge of the division of construction; a superintendent of maintenance, who is in charge of the division of maintenance, and a chief clerk, who is in charge of the division of auditing. Employees of the department are selected and retained on merit and are required to pass such examinations as may be prescribed by the commission. The salary of all employees of the department, including the director, is fixed by the commission subject to the approval of the governor.

The 1919 law provides that the State highway commission shall at the earliest possible moment lay out a system of State highways which shall reach each county seat in the State and each city or town of over 5,000 inhabitants. In compliance with this law the commission has laid out a system of State roads of about 3,600 miles, 3,200 miles of which are outside of incorporated towns. The commission is now considering the taking over of an additional mileage of roads to be maintained by the State as a part of the State system.

All State highways are constructed and maintained under the direction of the State highway commission and entirely at the State's expense, except certain sections of the system which will be built at the joint expense of the State and Federal Government. Approximately all construction work of the State highway commission during 1920 and 1921 has been done under Federal co-operation except some small bridges.

### Local Legislation

Road administration in the county is vested in a board of three commissioners, one being elected each year, who are also ex-officio boards of directors for all free gravel, macadam and turnpike roads.

The county surveyor is ex-officio engineer of the county, or in case of his inability to execute and to supervise engineering work the commissioners may appoint an engineer. The board also appoints a county highway superintendent to have general supervision of the maintenance and repair of all county highways and bridges. His term of office is four years. The county highway superintendent's salary varies from \$4.00 to \$6.00 a day, according to the mileage of highways under his supervision. The commissioners may increase this salary if in their judgment it is deemed to the best interest of the public to do so. The county highway superintendent is required by law to attend a road school of at least one week's duration each year, his expenses for such attendance being paid by the county in whose capacity he serves as county highway superintendent.

The legislature passed what is known as the county unit law, which provides that the county may ask and receive supervision of construction and review of plans and specifications by the State highway department, on petition of 50 or more freeholders to the county commissioners. The expense of this review and superintendence of construction is charged back to the county by the State highway department.

Road affairs of townships are under the jurisdiction of township trustees, one from each township, elected for terms of four years. They are assisted by supervisors elected for terms of two



years by the voters of each district into which each township is divided.

Counties may levy a tax at a rate not to exceed one cent on each \$100 of valuation for each 10 miles of country road for the maintenance of improved roads. In the townships, a tax not to exceed 30 cents on each 100 of valuation may be levied for road and bridge purposes. Two-thirds of this tax may be worked out on the township roads provided that an additional tax, paid in cash, of 10 cents on each \$100 valuation be levied for road and bridge purposes.

### **Bond Legislation**

Serial bonds in an amount not exceeding 4 per cent of the assessed valuation of the county or township may be issued for road and bridge purposes. The bonds are issued by county commissioners on a petition signed by 50 freeholders. They bear interest at the rate of not to exceed  $4\frac{1}{2}$  per cent, and are generally limited to 20 years. They are retired by an annual tax levied by the commissioners on all the property in the townships.

### **Convict Labor Laws**

The managing board of the State reformatory and State prison may, wherever there is no work for the inmates within the prison, arrange with the county commissioners or township trustees for working the convicts on the roads.

### **Automobile Registration**

The registration of automobiles is under the jurisdiction of the Secretary of State. The annual fees for passenger cars are as follows: less than 25 h.p., \$5; 25 to 40 h.p., \$8; 40 to 50 h.p., \$20; 50 h.p. and more, \$30; manufacturers' and dealers' licenses, \$25; manufacturers and dealers, \$25; electric passenger vehicles, \$5; motorcycles and chauffeurs' license, \$2.

The fees for trucks and delivery cars are as follows: 1 ton or less, \$6; 1 to 2 tons, \$15; 2 to  $3\frac{1}{2}$  tons, \$25;  $3\frac{1}{2}$  to 5 tons, \$50; 5 to  $7\frac{1}{2}$  tons, \$75. The fee for each trailer is \$3, \$6, \$10 and \$20 for 1, 2, 5 and  $7\frac{1}{2}$  tons capacity. No truck of more than  $7\frac{1}{2}$  tons capacity is permitted on the highways of the State.

### **State Road Funds**

During 1922 the State will receive its revenue for road purposes from three sources approximately as follows: Automobile license taxes, \$2,500,000; inheritance taxes, \$750,000; State levy of 33/100 of a mill on the dollar, \$2,250,000.

### Progress Report

The State highway commission completed about 82.5 miles of contracts for pavements during 1921. All of this but .65 miles had been contracted for in 1919 and 1920. The highway commission has repaired and maintained the whole State system, so that the larger part of the unpaved portion, consisting principally of gravel and stone roads, is in very fair condition for traffic the larger part of the year.

### State Highway Officials

The State highway commission consists of Charles W. Zeigler, chairman; Alvan V. Burch, vice chairman; Earl Crawford and Walter G. Zahrt, members; Lawrence E. Lyons, director; C. Gray, chief engineer of construction; A. H. Hinkle, chief engineer of maintenance; J. D. Williams, auditor.

Headquarters in State House, Indianapolis, Indiana.

Revised by A. H. Hinkle, chief engineer of maintenance.

## IOWA

### State and Local Legislation

The road building organization of Iowa consists of a State highway commission, 99 boards of supervisors of the 99 individual counties and 1,606 boards of township trustees.

The work of the State highway commission is conducted through a chief engineer, who is the active head of the organization. The road building activities of the individual counties of which the supervisors have charge is under the direct supervision of a county engineer in each county.

The general assembly of 1913 established the present highway commission, which consists of three members, giving it general supervision of all road and bridge work in the State.

The General Assembly of 1917 instructed the commission to select from the most important highways of the State a system of roads connecting every county seat and the more important market places of the State. The roads were to be selected by the highway commission with the advice and help of the boards of supervisors and county engineers. The legislature designated that this road system was to be called the Inter-county system. The greater portion of its mileage was taken from the county road systems. The same legislature also provided for the acceptance of the Federal aid money by the State and the setting aside of such a portion of the State automobile fees as might be necessary to match the Federal money dollar per dollar. The Federal money and the fund derived from State automobile fees was called the



Federal County Coöperation road-building fund. This money was apportioned to the various counties according to the area of the county. There was still no provision for bond issues for road building either by State, county or township, and no other method of anticipating road funds was provided.

In response to an urgent State-wide demand for more permanent highways, the 38th General Assembly in 1919 provided a financial system whereby the State and the individual counties might hard-surface the more important portion of their highways. The inter-county road system was adopted by the legislature as the primary or State road system. The State automobile license fees were approximately doubled and the increased funds thrown into a fund called the primary road fund, the Federal-county co-operation road fund being discontinued. The Federal allotments were also thrown into this same fund. This fund, it was instructed, should be used exclusively on the primary road system. No portion of it was to be spent on either the county or township systems. The county and township funds were somewhat increased and were left exclusively for use on the county and township road systems.

The primary fund is distributed to the various counties in proportion to their areas. The net balance in this fund on January 1, 1922, amounted to approximately \$5,285,753.61. The expenditure of the money is made by the boards of supervisors under the supervision of the State highway commission. The expenditures of every kind except maintenance must be upon projects approved by the State highway commission and the district office of the U. S. Bureau of Public Roads. Maintenance of the primary system which is entirely paid out of the primary fund is by the county officials. But the law provides that in case the maintenance is neglected, or is not entirely to the satisfaction of the commission, the commission may take over the work and charge the cost to the county's share of the primary road fund.

All bridge and culvert building costs on paving county and township systems must be paid by the county from county road levies. All cost of grading, drainage, and similar work on the primary system is paid from the primary road fund. When paving projects are contemplated, part of the cost is paid by the abutting property.

It is also provided that no hard surfacing can be done until the county at a popular election votes to authorize the general policy of hard surfacing. Provision is made that counties, if they desire to hard surface portions of their primary road system faster than the work can be done by the annual allotments which become available, may, after a vote of the people, issue bonds. The principal of these bonds is to be paid by the annual allotments

from the primary road fund to the county, but the interest upon the bonds must be paid by the county through a mileage levy.

In case of hard surfacing any highway, 75 per cent of the cost is paid from the primary fund. The remaining 25 per cent is assessed against the abutting property  $1\frac{1}{2}$  miles back from each side of the road, making a benefit zone of 3 miles wide. Provision is also made for hard surfacing portions of the county and township road systems. In case of an improvement on the township road system the county road funds must pay 25 per cent of the cost, the township road funds 50 per cent, and the remaining 25 per cent is assessed against the abutting property. In case of improvement on the county road system the county funds must pay 75 per cent of the cost and the remaining 25 per cent is assessed against the abutting property.

### **Convict Labor**

State convicts may be worked at stone quarries and the crushed stone produced furnished to the county or township f. o. b. cars at the crushing plant.

### **Automobile Registration**

All fees are collected and plates delivered by the county treasurer, who under provisions of the 1921 law retains all collections in the county treasury, sending in such portion of this collection as may be requisitioned by the State treasurer from time to time in order to keep the primary road fund balance above \$500,000. Two and one-half per cent of the gross revenue for the motor-vehicle license fees is set aside for the State Highway Commission as a maintenance fund and  $3\frac{1}{2}$  per cent to reimburse the State for the cost of collection.

The fees which are in lieu of all other taxes are as follows: One per cent of the factory list price plus 40 cents per 100 pounds weight of the vehicles. The minimum fee is \$10. Motorcycles have a flat rate of \$5. The net receipts from registrations amount to above \$8,000,000 a year.

### **Road Funds**

The total expenditures for roads and bridges in 1921 were \$38,741,627.53. The 1921 records show a total of \$16,996,806.68 expended on primary roads, \$5,766,483.50 expended on county roads, \$6,672,985.24 for township roads, and \$9,305,352.11 for bridge and culverts on primary, county and township roads systems. Between April 1, 1919, and January 1, 1922, 14 counties



voted \$18,475,000 in road bonds for hard roads and up to January 1, 1922, a total of 27 counties had voted for hard surfacing.

Funds available in 1922 are approximately as follows:

On primary roads:	
Primary funds .....	\$12,000,000
Bond issues .....	5,000,000
Special assessments .....	1,000,000
On county roads:	
County road levies.....	4,500,000
On township roads:	
Township road levies.....	6,000,000
Bridge funds:	
From county and township levies and spent on primary, county and township roads.	9,000,000
	<hr/>
	\$37,500,000

### Progress Report

Total mileage of Iowa roads outside of incorporated towns and cities is 104,082, divided as follows: Primary roads, 6,616; county roads, 10,681.15; township roads, 86,785.

Up to date, including an estimate on the 1921 mileage where exact figures are not known, there are approximately 238 miles of highway improved with paving, either concrete or brick; 2,346.38 miles of gravel surfacing; 2,542 miles of road put to permanent grade, with cuts and fills made and built to standard cross section; many thousand miles have been built to standard cross section on natural grade lines, chiefly tractor, blade grader maintenance work. The 2,542 miles of permanently graded highway is approximately one-third of the primary road system and represents a sub-grade that is practically ready for the laying of hard surfacing.

### State Highway Officials

State Highway Commission: William Collinson, Chariton, Iowa, chairman; Dean A. Marston, Ames, Iowa; J. W. Holden, Scranton, Iowa; Fred W. White, chief engineer.

Revised by J. W. Eichinger, bulletin editor.

## KANSAS

### State Highway Legislation

At the general election November 2, 1920, a constitutional amendment permitting the State to engage in the construction of highways was passed. This amendment provides that the State may aid in the construction of highways to the extent of twenty-five per cent of the cost, but not more than \$10,000 per mile, or more than 100 miles in one county excepting in counties having

an assessed valuation of more than \$100,000,000, where such aid may be granted for not more than 150 miles of highway.

Legislation for carrying out the constitutional amendment was adopted in 1921. This law provides that after deducting from each motor vehicle license other than motorcycles or dealers' license the sum of 50 cents for the Secretary of State and \$4.50 for the special road drag fund, the balance shall be placed by the county treasurer in the State-aid fund of the county. All the revenue from dealers and motorcycle license is placed in this fund as well as all unexpended balance from the Secretary of State's tag fund and the balance from the drag fund remaining at the end of the year.

The county board designates the location and character of improvement and notifies the State highway commission. All plans, specifications and estimates must be approved by the State highway engineer and all vouchers must be approved by the State highway commission. In counties of over 7,500 population the State aid can only be applied where the benefited land is assessed 25 per cent of the cost after deducting Federal aid, State aid and donations. The aid may be applied to any type, including earth roads of a permanent character.

The 1917 legislature created the State highway commission for the purpose of cooperating with the Federal Government in Federal-aid road construction. The commission consists of the Governor, ex-officio chairman, and two members appointed by the Governor with four-year terms. The State highway engineer and other employees are appointed by the commission for an indefinite period. It was further provided that the counties were authorized to raise the money to furnish the State's share of the cost of constructing Federal-aid highways and that the construction would be in complete charge of the State highway commission.

The State highway commission has general supervision over all road and bridge work in the State. All county road systems must be approved by the State highway engineer and the work performed on this system be in accordance with plans approved by the State highway engineer. All bridges on county roads must be built in accordance with plans approved by the State highway engineer and all bridges on township roads the cost of which exceeds \$2,000 must first be approved by the State highway engineer.

### **Local Legislation**

The jurisdiction of county roads is vested in the board of county commissioners and the county engineer and of township roads in the board of township highway commissioners and road overseer, with the necessary approval of the county engineer, in some cases. The county commissioners of the county are re-



quired to appoint, subject to the approval of the State highway commission, a county engineer to supervise the work on all county roads and to assist the township officials in improving and maintaining roads under their jurisdiction, also to prepare and approve plans for bridges constructed by the townships. The township highway commissioners are required to employ a road overseer to supervise the construction and maintenance of township roads and mail routes.

### Bond Legislation

On a petition of 51 per cent of the resident land owners owning 35 per cent of the land or 35 per cent of the resident land owners owning 51 per cent of the land, or the owners of 60 per cent of the land lying within a benefit district, the petition naming the type of improvement, the width, the terminal points and other specifically fixed locations and the number of annual assessments, not less than 10 nor more than 20, to be made in payment therefor, the county commissioners are authorized to improve the road if it is found to be of public utility. The county commissioners are empowered to make contracts or to construct the road by the day-labor system and to issue bonds in payment therefor, bearing interest not to exceed 6 per cent annually, within the time mentioned in the petition. The county commissioners are further authorized to cooperate with the State highway commission for the purpose of securing Federal aid under the benefit district law. All plans, specifications and estimates for the improvement must be submitted to the State highway engineer for approval before the work is started, and on Federal-aid work the construction is under the direct charge of the State highway engineer.

After all Federal aid, donations or subscriptions have been deducted, the cost is distributed as follows: 50 per cent to the county,  $12\frac{1}{2}$  per cent to the townships in the benefit district on a ratio of the land in the benefit district lying in each township,  $12\frac{1}{2}$  per cent to the townships through which the road passes on the ratio of the length of road in each township, and 25 per cent to the land in the district. The charge against each piece of land in the district is determined by the county commissioners according to the benefits that accrue to the land and the improvements thereon. Each land owner in the district is given an opportunity to pay his portion of the cost in cash or to allow it to run for the term of the bonds. The county is required to pay for all bridges costing over \$2,000 or having a span greater than 20 feet.

The county commissioners are also required to call an election for issuance of bonds to construct at least 30 miles of road upon petition of 20 per cent of the resident land owners within the county. They are also authorized to make a special levy for

the construction of at least 30 miles of road when a petition is filed and carried by an election, the levy not to exceed 3 mills on the dollar annually. The county commissioners are also authorized to levy a general road tax of not less than one-fourth and not more than  $1\frac{1}{2}$  mills for the purpose of constructing and maintaining the county road system.

The bridge levy authorized by law is not to exceed one and one-half mills for county bridge work and the county is not authorized to construct a bridge costing over \$40,000 in certain counties and \$50,000 in other counties without submitting the question to vote; but by submitting the question to an election and by a majority of votes cast the county is authorized to issue bonds for five-year period for the construction of larger bridges. The board of township highway commissioners is authorized to levy not to exceed 3 mills for road and bridge construction.

### **Convict Labor**

State convicts may be employed on roads or for the preparation of road-building materials, but none have been so employed to date on account of the need of the services of all prisoners at the penitentiary. County prisoners may be employed on road work.

### **Automobile Registration**

Automobiles are registered annually with the Secretary of State. The fees are as follows: Motorcycles, \$5; passenger automobiles, minimum fee, \$8, plus 50 cents for each 100 pounds gross weight in excess of 2,000; electrics, \$10; motor trucks having a rated carrying capacity of 1 ton or less, \$15; 1 to  $1\frac{1}{2}$  tons, \$22.50;  $1\frac{1}{2}$  to 2 tons, \$30; 2 to  $2\frac{1}{2}$  tons, \$37.50;  $2\frac{1}{2}$  to 3 tons, \$45; 3 to 4 tons, \$70; 4 to 5 tons, \$100, plus \$25 for each additional ton of carrying capacity.

The revenue derived from registration is paid to the county treasurer and on each license fee collected 50 cents is forwarded to the Secretary of State for the upkeep of his department.

### **Road Funds**

The estimated expenditures for road purposes in Kansas during 1921 was \$20,000,000, divided as follows: County road and bridge fund, \$7,303,928; township road and bridge fund, \$4,619,056; automobile fund, \$3,000,000; one-half of township general fund, \$1,036,013; estimated poll tax, \$525,000.

The amount of funds available during 1922 will at least equal the amount stated above for 1921, with a decided increase in automobile license funds and a probable increase of the county road and bridge fund.



### Progress Report

The total mileage of public highways in Kansas, exclusive of the streets of incorporated towns and cities, is about 124,143. Approximately 15,983 miles of these roads are in the county road system. The county roads are mostly earth, fairly well graded and maintained. At the beginning of the year 1919 there were only about 450 miles of improved roads, consisting of gravel, macadam, brick, and concrete, and about 900 miles of sand-clay and oiled dirt roads.

During 1919, 1920 and 1921 there were placed under contract Federal-aid road work amounting to a total of 567 miles. Of this amount there were completed on December 31, 1921, a total of 449 miles of all types—earth, 143 miles; brick, 54 miles; concrete, 144 miles; macadam, 30 miles; gravel, 78 miles. New road work financed to date amounts to approximately \$50,000,000, covering about 1,500 miles of road, all of which will be constructed with Federal aid if sufficient funds are obtained from the government by a continuation of the Federal-aid plan.

### State Highway Officials

The State highway commission consists of Governor Henry J. Allen, ex-officio chairman; Fred Perkins, Oswego, commissioner; A. C. Blair, of Lyons, commissioner; M. W. Watson, State highway engineer; W. V. Buck, assistant State highway engineer; F. W. Epps, bridge engineer; C. I. Felps, Topeka; G. L. Campbell, Salina; A. A. Anderson, Hutchinson; and L. P. Scott, Fort Scott, division engineers.

Prepared by M. W. Watson, State highway engineer.

## KENTUCKY

### State Highway Legislation

The general assembly of Kentucky, in 1920, abolished the State-aid law save for the completion of all contracts awarded prior to July 1, 1920, under its provisions. There was enacted, in place of this law, a new law creating a bi-partisan State highway commission, composed of two members each from the two dominant political parties of the State. This bi-partisan board, in turn, selects a State highway engineer and approves the appointments of all his assistants.

A State system of proposed primary roads has been created, of approximately 4,000 miles in length. The total estimated length of roads of all classes in the State is 53,000 miles. Of this a total of 990 miles were constructed or reconstructed under State and Federal-aid. The engineering construction and maintenance of

such roads are under the supervision of the State highway commission and no State and Federal funds can be used for any other purpose than on this proposed primary system.

### Local Legislation

County road and bridge affairs are administered in the 120 counties by fiscal courts composed of the county judge and a magistrate from each magisterial district of the county. There are a few counties in which road affairs are administered by three or more commissioners who are elected by the people. All of the above officials are elected for terms of four years. The county clerk is clerk to the governing body and the county treasurer is fiscal agent.

The governing body of the county may appoint as county engineer one who is required to be either a reputable civil engineer or a man who has had two years' practical experience as a road builder and who shall have passed an examination held by the State commissioner or his representative. He serves as the executive official of the county in all road and bridge matters and receives general instructions from the State commissioner relative to standards and types of construction, gradients, etc., of all public roads and for plans for all bridges costing \$500 or more.

Current revenues are obtained from an ad valorem tax levied at a rate not to exceed 50 cents on each \$100 of taxable property, one-half of which may be used for road purposes. The fiscal court may authorize counties to vote an additional tax of 20 cents on the \$100 valuation for road purposes. A poll tax may be levied for road purposes on male inhabitants over 21 years of age at rates which vary in the different counties. These funds are expended by the fiscal court or other governing body for all county purposes, including road and bridge expenditures. Six days' statutory labor on the roads may be required for all able-bodied male citizens between the ages of 18 and 45, but this tax is not generally observed.

### Bond Legislation

On the petition of 150 voters and free-holders of a county, the county court shall call an election to determine whether bonds of the county shall be issued in an amount not to exceed 5 per cent of the taxable valuation of the county. If two-thirds of the legal voters voting shall favor the issuance of bonds, the fiscal court may issue them, to bear not exceeding 5 per cent interest, to run not less than 5 nor more than 30 years, and to be sold for not less than par. The fiscal court shall levy an annual tax of not to exceed 20 cents on each \$100 valuation of taxable property in the county, to pay the interest on such bonds, and to create a sinking fund for their redemption at maturity. Sinking fund accumulations



may be loaned by the fiscal court on first mortgage real estate security, on the basis of 50 per cent of its value.

Any county which issues bonds and expends the proceeds thereof for building public roads under the direction of the commissioner of public roads, in an amount greater than the amount which said county may be able to secure by apportionment from the State road fund for that year, shall be entitled to receive from the State road fund in subsequent years such further amounts or apportionments as will make the total amount ultimately received from said fund equal to one-half the amount so expended by said county.

### Convict Labor Laws

The State may employ the State convicts outside the walls of the penitentiary in road or bridge work, or in the preparation of materials therefor. Eight convict labor gangs are at present engaged in State-aid operation under this law.

Because of the difficulty of managing convict labor camps under dual authority (State board of charities and corrections, and the State highway department) also, owing to the decrease in wages of free labor to an amount very nearly that paid convict labor, the State highway commission has decided to abandon convict labor method of constructing roads.

County prisoners sentenced to work at hard labor may be placed in the work house, if there be one in the county, or at work upon the public works, or roads, of the county, or upon the public works of any city or town in the county.

### Automobile Registration

The legislature of 1920 changed the automobile law materially. The fee for passenger cars was increased to 60 cents per h. p. For trucks the minimum fee is \$22 for a  $\frac{1}{2}$ -ton truck, while for a 1-ton truck it is \$30. This increases by \$10 for each  $\frac{1}{2}$  ton to \$70 for a 3-ton. For a 3 to  $3\frac{1}{2}$ -ton the rate is \$90, and this rate increases by \$20 for each  $\frac{1}{2}$  ton up to 5, when the rate is \$150. For trucks having a capacity of more than 5 tons the rate shall be \$50 for each additional ton. There is also a gasoline tax of 1 cent per gallon.

### Road Funds

In the fiscal year 1921, the State road fund amounted to \$5,390,425, of which \$1,756,460 was derived from automobile license fees, \$671,348 from the three-tenths of a mill State-wide tax, \$345,831 from the 1 cent per gallon tax on gasoline, and \$1,375,526 from other sources including Federal-aid. The balance on hand at the beginning of the year was \$1,241,260. From which is to be deducted for the liquidation of—

State-aid claims . . . . .	\$615,700
For State road maintenance (approximately) . . . . .	300,000
Total deduction . . . . .	<u>\$915,700</u>
State road fund, 1921, including Federal aid funds . . . . .	\$4,474,700
Approximate county contributions and private subscriptions . . . . .	250,000
Total available funds, exclusive of maintenance and State-aid debt . . . . .	<u>\$4,724,700</u>
There was expended by this department during 1920 approximately . . . . .	\$2,000,000
In Federal-aid and in State-aid . . . . .	2,000,000
Or a total approximate expenditure of . . . . .	<u>\$4,000,000</u>

The estimated amount to be expended on Federal and State primary roads in 1922 is derived as follows:

Federal-aid funds . . . . .	\$1,400,000
Automobile license fees . . . . .	2,000,000
Gasoline tax . . . . .	400,000
Three-tenths mill tax . . . . .	600,000
County contributions and private subscriptions . . . . .	250,000
Total . . . . .	<u>\$4,650,000</u>
For liquidation of State-aid claims . . . . .	\$500,000
For maintenance . . . . .	500,000
	<u>\$1,000,000</u>
Approximate amount available for road construction in 1922 . . . . .	<u>\$3,650,000</u>

The last amount closely represents that to be expended by the road department on construction during 1922 unless the legislature which convened in January, 1922, provides other sources of income.

### Progress Report

There was constructed under State and Federal-aid acts, in 1921, the following types and mileage of roads:

	<i>Miles</i>
Waterbound macadam, surface treated . . . . .	28.9
Earth . . . . .	176.3
Gravel . . . . .	40.6
Waterbound macadam . . . . .	99.3
Bituminous macadam . . . . .	11.4
Rock asphalt . . . . .	22.4
Cement concrete . . . . .	6.6
Brick . . . . .	.7
Surface treated macadam . . . . .	204.4
	<u>590.6</u>



### **State Highway Officials**

Chairman of commission, H. Green Garrett; members, H. H. Asher, Ed. S. Monohan; and Ben Weille, secretary; State highway engineer, Joe S. Boggs. Headquarters, Frankfort.

Revised by J. T. Madison, general inspector.

## **LOUISIANA**

### **State Highway Legislation**

In 1910, the State highway department was organized and the distribution of State aid in the form of money aid and use of prison labor under the supervision of the State highway department was made a permanent State policy.

It having become apparent that the ways and means provided under existing laws were not sufficient to meet the growing demand for good roads, during 1921 a State constitutional convention was held, which provided for the creation of a highway commission and authorized the passage of special laws for the purpose of providing funds for the building and maintenance of a system of hard-surface highways to traverse the entire State.

Under this authorization, at a special session of the legislature, also held in 1921, an act was passed creating the Louisiana highway commission, to consist of three members to be appointed by the governor. The commission selects and appoints a State highway engineer who, with the approval of the commission, appoints and fixes the compensation of such assistant engineers and subordinates as may be necessary to the proper conduct of the work of the commission.

A State-wide system, comprising about 7,000 miles of hard-surface roads, connecting parish (county) seats and important commercial centers, and linking up with the various National highway systems and the highway systems of neighboring States, has been planned. Not over 25 per cent of the cost of these roads is to be borne by the parishes; the balance will be paid out of State and Federal-aid money.

### **Local Legislation**

The parishes correspond in size, organization, and power to counties of other States. Their affairs are administered by a police jury consisting of an elective member from each of the wards into which the parish is divided. The members elect one of their number as president and employ a non-member as secretary.

The police jury has jurisdiction over all road and bridge work in the parish, except State roads; may levy taxes, issue bonds and in all respects is a body politician.

### **Bond Legislation**

Bonds may be issued in amounts not exceeding 10 per cent of the assessed valuation of parishes or districts when authorized by a majority in number and assessed valuation of the property-owning voters. The term of such bonds may not exceed 40 years and the rate of interest may not exceed 5 per cent. The bonds must be retired annually, beginning at a date not later than 5 years from the date of issue.

### **Road Funds**

In order to provide funds for the system of highways planned, a new scale of rates for motor-vehicle licenses was provided, the new rate for motor-vehicle registration being 68 cents per h. p. plus \$10 to \$25 per 1,000 pounds for motor trucks. An extra charge of from \$2 to \$10 per passenger capacity is also provided for all passenger vehicles operating for hire. A tax of 1 cent per gallon on all gasoline or motor fuel sold in the State for domestic consumption was also levied. The new legislation also provides a fee of \$5 for the registration of chauffeurs.

From the above sources, it is estimated that there will be \$2,500,000 available for road construction and maintenance during 1922, in addition to \$999,000 Federal aid allotted the State. The registration receipts are estimated at \$1,750,000 and the fuel tax at \$750,000.

### **Progress Report**

During the year 1921, 300 miles of hard-surface highways were completed in the various parishes, bringing the total up to approximately 2,000 miles, outside of cities. In 1922, contracts for approximately 350 miles will be let.

### **State Highway Officials**

State highway commissioners: Wilson T. Peterman, chairman; Duncan Buie, vice-chairman; Arthur Taylor, secretary; James M. Fourmy, State highway engineer; W. F. Cooper, assistant State highway engineer, and Wm. H. Rhodes, maintenance engineer.

## **MAINE**

### **State Highway Legislation**

The State highway commission appointed by the governor, with the advice and consent of the council, consists of three members. Their term of office is three years, one commissioner's term expiring each year. The commission selects and appoints, with the approval of the governor and council, a chief engineer, upon



terms to be fixed by the commission subject to the approval of the governor and council. The chief engineer, under the direction and control of the commission, has general charge of the office, the records and all construction and maintenance work, and may, with the approval of the commission, employ necessary engineers, supervisors, assistants and help.

The commission is authorized to lay out, construct and maintain a system of State and State-aid highways, the State highways to be constructed wholly by the State from the bond issue and mill tax fund, and the State-aid highways to be constructed by the State and municipalities jointly. Both classes of highways are to be maintained under the direction of the commission, the cost to be borne jointly by the State and municipalities. The charge against the municipalities for maintenance of State highways shall be \$60 per mile per annum; and for State-aid highways, one-half the actual expense, but not to exceed \$30 per mile per annum.

Towns may cooperate with the State in the employment of a regular patrolman to perform maintenance work, in addition to that upon the State highway or State-aid highway, upon such mileage of road as shall be mutually agreed upon by the municipal officers of the town and the State highway commission. For each mile so maintained the towns shall pay to the State a sum equal to the average amount per mile of road raised by the town for the support of highways. This amount must not be less than \$30 nor more than \$60 per mile.

The commission has full charge (except that in the case of State highways, not advertised for bids, the approval of the governor and council is required) in letting of contracts for the construction of all State and State-aid highways. The commission may make contracts with towns for construction of State-aid roads without advertising for bids, and towns may submit bids for State or State-aid highways.

Towns may make the following appropriations and apply for State aid: Towns having a valuation of \$200,000 or less may appropriate any amount not exceeding \$300; towns having a valuation of over \$200,000 and not over \$800,000 may appropriate any amount not exceeding \$533; towns having a valuation of over \$800,000 and not over \$1,000,000 may appropriate an amount not exceeding \$600; and towns having a valuation of over \$1,000,000 and not over \$3,000,000 may appropriate in addition to the sum of \$600 a sum of \$66 for each \$200,000 or fraction thereof valuation in excess of \$1,000,000; towns having a valuation of over \$3,000,000 and not over \$4,000,000 may appropriate not exceeding \$1,333, and towns having a valuation of \$4,000,000 may appropriate in addition to the sum of \$1,333 a sum not exceeding \$133 for each additional \$1,000,000 of additional valuation.

The commission from the funds for State-aid construction shall apportion to each town, which has conformed to the provisions of the act, for each dollar so appropriated, the following amounts: To each town having a valuation of \$200,000 or less, \$2.66 for each \$1 appropriated by said town; to each town having a valuation of over \$200,000 and not over \$1,000,000, \$1.33 for each \$1 appropriated by said town; to each town having a valuation of over \$1,000,000 and not over \$1,200,000, \$1.22 for each \$1 appropriated by said town; to each town having a valuation of over \$1,200,000 and not over \$1,400,000, \$1.13 for each \$1 appropriated by said town; to each town having a valuation of over \$1,400,000 and not over \$1,600,000, \$1.07 for each \$1 appropriated by said town; to each town having a valuation of over \$1,600,000, \$1 for each \$1 so appropriated by said town. The money appropriated by towns applying for State aid, with the amount apportioned by the commission, shall constitute a joint fund for the construction and permanent improvement of the State-aid highways in such towns.

Between the 15th day of July and the 15th day of August in each year municipal officers prepare and file with the commission suggestions for the improvement during the next calendar year of State-aid highways located in each town, accompanied by plans so far as practicable, setting forth the location of the highways and the nature of the improvement desired. The commission examines and reports thereon with its recommendations to the municipal officers on or before the 20th day of February following. Such reports are submitted to the voters of such towns at the next regular meeting.

The sum of \$300,000 is appropriated annually for the construction of State-aid highways in the 500 cities and towns which make application. In addition to this there is a mill tax on the valuation of the State roads which for the calendar year of 1921 was \$637,403.43. This is called the Mill Tax Highway Fund and is distributed as follows: \$200,000 for State-aid construction, one-third of a mill, or \$212,467.81 in 1921 for third-class highways. Not more than one-sixth of a mill, or \$105,851 in 1921 for the construction of highways, bridges and other purposes in accordance with the terms of any appropriate resolve of the legislature, and the balance of \$119,085.62 in 1921 is available for the construction or maintenance, or both, of State highways, making a total amount of \$818,317.81 of strictly State-aid construction funds.

The maintenance of all the principal thoroughfares in the State, both improved and unimproved, except in the cities and compact portions of towns of over 2,500 population, is under the direction of the State highway commission, the work being done at the joint expense of State and town.



Automobile registration revenue is paid into the treasury and credited to a fund for paying the interest on and maturity of the bonds and for the administration of the department and for maintenance.

### **Highway Bonds**

A resolve of the legislature in 1919 authorized the issuing of bonds not exceeding \$10,000,000 in amount at any one time payable within 41 years, which bonds or their proceeds shall be devoted solely to the building of State highways and intrastate, interstate and international bridges.

The legislature has authorized to date, after deducting maturities paid, \$7,514,500. Of this amount, \$1,250,000 authorized has not been issued, and there is left of the total \$10,000,000, \$2,485,000 for which an authorization by the legislature is necessary to make it available by order of the governor and council.

### **Local Legislation**

Jurisdiction over roads vests in the boards of county commissioners of the 16 counties in the case of certain small unorganized townships; all other local roads are under the boards of selectmen of the towns and the municipal officer of cities and organized plantations.

### **Convict Labor Laws**

Upon written application from county or municipal authorities the board of prison inspectors may direct that jail prisoners be worked on county roads.

### **Registration and Licensing of Motor Vehicles**

Passenger cars equipped with pneumatic tires, 25 cents per h. p. plus 25 cents per 100 pounds of weight; if equipped with solid tires the rate is 25 cents per h. p. plus 50 cents for each 100 pounds of weight. Motor vehicles for livery or hire, double above fees.

The rate for tractors equipped with pneumatic and solid tires is the same as for passenger cars, but if equipped with iron, steel or other hard tires, the rate is 25 cents per h. p. plus 80 cents for each 100 pounds of weight. Tractors used for agricultural purposes, one-tenth of the above rates. The rate for caterpillar tractors is \$15, but if not used on highways, there is no fee.

The rate for trailers equipped with pneumatic tires is 15 cents per 100 pounds gross weight of vehicle and load. If equipped with solid tires the rate is 40 cents per 100 pounds, and if equipped with iron tires, the rate is 75 cents per 100 pounds. The rate for motorcycles is \$5 each, with \$5 added for side cars.

The fees for motor trucks are based on carrying capacity; 1,000 pounds or less, \$10; over 1,000 pounds, \$15. One to two tons, \$20; two to three tons, \$55; three to four tons, \$80; over four tons, \$110. The rate for motor trucks equipped with solid tires is  $33\frac{1}{3}$  per cent higher than those above given.

### Progress Report

#### STATEMENT OF MILEAGE AND EXPENDITURES ON STATE-AID ROADS, 1901 TO 1921 INCLUSIVE:

Year	Miles	Cost
1901-1906 .....		\$ 441,123.22
1907 .....	363.02	172,816.96
1908 .....	82.84	266,611.86
1909 .....	79.54	288,484.49
1910 .....	113.42	428,638.74
1911 .....	111.57	421,779.57
1912 .....	117.11	631,027.54
1913 .....	169.66	871,072.09
1914 .....	158.64	748,796.76
1915 .....	176.74	676,049.29
1916 .....	157.06	554,557.03
1917 .....	114.31	566,623.46
1918 .....	112.44	609,482.21
1919 .....	147.88	947,971.89
1920 .....	181.49	1,231,088.24
1921 (approximate) .....	200.00	1,300,000.00
Total .....	2,285.72	\$10,156,123.35

Of the above mileage, 80 per cent is gravel, the balance being macadam, concrete, bituminous macadam, sand-clay and miscellaneous.

#### STATEMENT OF MILEAGE AND EXPENDITURES ON STATE HIGHWAYS 1914 TO 1921 INCLUSIVE:

Year	Miles	Expenditures
1914 .....	44.02	\$ 755,684.59
1914-1915 .....	87.89	
1915 .....	52.73	527,906.03
1915-1916 .....	6.90	
1916 .....	104.52	465,735.89
1916-1917 .....		
1917 .....	32.14	441,930.98
1917-1918 .....	25.00	
1918 .....	37.61	655,475.71
1919 .....	3.91	289,025.79
1920 .....	50.88	1,319,194.18
1921 .....	98.40	2,756,319.35
Total .....	544.00	\$7,211,272.52



## STATE HIGHWAYS

Types	Miles
Gravel.....	337.45
Macadam.....	4.78
Concrete.....	17.00
Sand-clay.....	6.75
Bituminous macadam.....	91.16
Gravel and macadam.....	6.68
Clearing and Grubbing.....	22.21
Grading.....	8.93
	<hr/> 494.96

## Maintenance

Maintenance work during 1921 was performed generally by the patrol system. There were 482 patrolmen employed in caring for 4,306 miles of road in 479 towns. Of this mileage 738 was improved State highway, 1,057 miles was improved State-aid highway, and the balance, or 2,511 miles, was unimproved road. There was also maintained by special arrangement with the towns 147 miles of improved State-aid roads.

A total expenditure for labor and material of \$827,842 was made on this work, including \$18,120.72 furnished by the State for road-machine work. The State also furnished supervision and inspection for the work amounting to \$38,700, making the total gross expenditure chargeable to maintenance of \$866,542. Of this amount the State furnished \$626,335 and the cities and towns furnished \$240,207.

## State Highway Officials

State Highway Commission, Augusta.—William M. Ayer, chairman; Frank A. Peabody, Lyman H. Nelson, Paul D. Sargent, chief engineer; I. W. Barbour, assistant engineer, State highways; L. D. Barrows, assistant engineer, State-aid highways; A. J. Wiggin, superintendent of maintenance; L. N. Edwards, bridge engineer.

The department is made up of 23 State highway engineers and assistants, 7 bridge engineers, 25 State-aid and maintenance supervisors, and 16 clerks and stenographers.

Revised by I. W. Barbour, assistant engineer, State highways.

## MARYLAND

### State Highway Legislation

The State roads commission, consisting of three members appointed by the governor, has direct control over the construction and maintenance of a system of main highways through all the counties in the State, the cost of such construction and maintenance to be borne entirely by the State. The commission also has authority over the building of "lateral" roads not included in the trunk-line system, and when such work is contemplated the plans and specifications are prepared by the State, the contracts awarded, and the work of construction supervised by the State.

The cost of lateral roads is shared equally by the State and counties. The allotment of State funds to the counties is based upon road mileage. After the construction of a lateral road, its maintenance devolves upon the State.

The system of trunk-line roads, built and maintained entirely at the expense of the State, was authorized by the legislature in 1908, and a State bond issue of \$5,000,000 was authorized for this purpose. An additional bond issue of \$1,000,000 was authorized by the legislature in 1910; in 1912 an issue of \$3,170,000 was authorized; \$6,600,000 in 1914, \$2,700,000 in 1916, \$3,000,000 in 1918, and \$3,000,000 in 1920, making a total of \$24,470,000.

An Act passed by the legislature in 1920 provides that the appropriation of \$3,000,000, or proceeds thereof, be used for the construction of rural post roads, lateral roads and the extension of the State road system, with the assistance of funds from the United States Government and the several counties of the State. The principal amount of said loan shall be paid upon the serial annuity plan, and all within fifteen (15) years after the issuance thereof. One-half of this amount, or \$1,500,000, has been set aside for the purpose of constructing lateral roads, this money being apportioned to the counties on the basis of road mileage in the several counties, the counties to match the State's money by bond issues, special assessments or otherwise. The money so raised by the counties shall be paid to the State roads commission at such time and in such amounts and under such guarantees as the State roads commission shall from time to time determine.

There is a total of 14,810 miles of road in the State, of which 1,852 miles have been taken over and improved by the State roads commission.

Funds for the maintenance of State highways are provided from the receipts of the Commissioner of Motor Vehicles from license fees, etc.

Under the Federal-aid act passed by Congress, there has been apportioned to Maryland \$3,031,378. Project statements have



been submitted to the bureau of public roads on 61 sections of road aggregating 208.27 miles in length, with an approximate total cost of \$5,528,566. Project agreements have been signed by the Secretary of Agriculture and the State roads commission for a total of 174.99 miles of road, the cost of which will be approximately \$4,829,216. Federal-aid roads amounting to 155 miles were completed and paid for up to January 1, 1922.

### **Local Road Legislation**

Jurisdiction over county roads vests in elected boards of county commissioners, who may employ competent civil engineers for the construction and maintenance of roads and bridges.

### **Convict Labor**

For the purpose of building and constructing or maintaining any road, bridge or highway or for the purpose of working any stone quarry operated by the State roads commission, the commission is authorized to make request of the board of prison control for as many inmates of the Maryland penitentiary or the Maryland house of correction as may be necessary for the purpose, and the board of prison control is directed to furnish them, together with a sufficient number of guards for the safekeeping of the prisoners while so employed.

### **Automobile Registration**

The annual registration fees are paid to the commissioner of motor vehicles and are: 60 cents per h. p. for motor vehicles with pneumatic tires; for a motor vehicle with solid tires and a rated capacity not exceeding 1 ton the fee is 20; not exceeding 2 tons, \$40; 3 tons, \$60; 4 tons, \$100; 5 tons, \$150; 6 tons, \$300; and 7 tons, \$500; \$10 for trailers with a rated capacity not exceeding 1 ton after any motor vehicle, plus \$20 for each additional ton capacity up to a maximum of 7 tons. Motorcycles, \$5 per annum, plus \$3 for a side car; \$3 for bicycle with motor attachment; \$25 for two sets of dealer's tags and \$12 for each additional set available on all cars of a dealer not used for hire; \$20 for four tags for motorcycles; \$1.20 per h. p. for motor vehicles transporting persons for hire, other than vehicles operating on fixed schedules; motor vehicles operating on schedule for passenger service, fee per passenger seat per mile of total annual scheduled mileage, 1/20 cent for vehicles under 3,000 lbs., 1/15 cent for vehicles weighing 3,000 to 7,000 lbs., 1/6 cent for vehicles weighing over 7,000 lbs.; fee for freight motor vehicles operating on schedule, per ton capacity per mile of total annual scheduled mile-

age, 1/5 cent for trucks weighing less than 3 tons loaded, 2/5 cent for trucks weighing 3 to 6 tons, 3/5 cent for trucks weighing over 6 tons; operator's license, \$2; chauffeur's license, \$3 per annum.

One-fifth of the net registration revenue is apportioned to the City of Baltimore for use on its roads and streets, and the remainder is expended for oiling, repair and maintenance of the modern State and county roads. Fines and forfeitures are paid into the State treasury for the same use as the registration revenues.

The commissioner of motor vehicles is authorized to expend from the receipts of his office each year not exceeding \$1,000 for the erection of sign posts for the direction of and warning of danger to travelers. The commissioner is also authorized to employ deputies equipped with motorcycles to enforce the motor vehicle and traffic laws of the State and pay them from the receipts of his office.

No motor vehicle in excess of 90 inches width, or in which the limit of load is over 650 lbs. per inch in width of tire, may be operated on the highways of the State without special permit from the State roads commission, if a State road, or the proper authorities of other roads. No motor vehicle of which the weight of truck and load exceeds 14 tons shall be operated on any highway.

### State Road Funds

There was available for construction and maintenance of State and lateral roads during 1921 a balance of approximately \$2,950,000 from the year 1920; and in 1921, \$1,600,000 from the State bond issue for the construction of State roads; \$1,600,000 from automobile revenues collected during 1921 for maintenance of State and lateral roads, a total of approximately \$6,150,000. There is available during 1922, for construction, \$1,540,000, and for maintenance, \$1,800,000. The automobile money does not include the funds turned over to Baltimore City, which consists of one-fifth of the total net collections.

### Progress Report

During 1921, the following contracts were awarded:

Penetration macadam .....	15.29	miles, \$	253,373
Concrete .....	97.84	"	3,231,002
Gravel .....	25.02	"	232,056
Sheet asphalt .....	7.35	"	293,694
Asphalt on recon. base.....	1.86	"	51,152
Concrete shoulders .....	14.56	"	174,384
Grading only .....	1.03	"	32,772



Twelve miles concrete, five miles asphalt, and nine miles of gravel construction were carried over to 1922.

The total mileage of State and lateral roads constructed to date is 1,852 miles, all of which is being maintained by and at the expense of the State under the patrol system.

### State Highway Officials

Chairman and chief engineer, John N. Mackall; Omar D. Crothers and D. C. Winebrener, commissioners; Lamar H. Steuart, secretary; counsel, Alexander Armstrong, attorney general; E. Austin Baughman, commissioner of motor vehicles.

Highway Department—John N. Mackall, chief engineer; Harry D. Williar, Jr., assistant chief engineer; Walter C. Hopkins, bridge engineer; Robert M. Reindollar, engineer of surveys; Leo T. Downey, W. F. Childs, Jr., Edwin Friese, Douglas P. Campbell, George H. Parker, Austin F. Shure, P. E. Burroughs, district engineers.

Revised by Lamar H. Steuart, Garrett Building, Baltimore.

## MASSACHUSETTS

### State Highway Legislation

State highway work is now carried on by the division of highways of the department of public works which is presided over by the commissioner of public works.

The organization is as follows: a central office at Boston with three commissioners, of which the commissioner of public works is chairman, a secretary, the various assistants in the highway division, the motor vehicle department, and a chief engineer. The State is divided into seven districts, each in charge of a district engineer, who has the necessary assistants and resident engineers, who are employed directly on the work.

The duties of the division of highways relate to roads and automobiles. Its duties so far as they relate to the roads are: (a) The collection of statistics as to road materials and road conditions in the State, the making of maps, the giving of advice to local road authorities, etc.; (b) the laying out and construction of State highways, the improvement of certain town roads, and the supervision of maintenance of State highways.

The State highways are such as are designated by the division upon petition of the city government, the board of selectmen, or the county commissioners. As soon as the highway has been thus designated it passes under complete jurisdiction of the State department of public works, which has control not only of construction and maintenance but also of the location of water and gas mains,

poles or other structures, the planting or cutting down of trees on the right of way, etc.

The cost of constructing State highways is borne as follows: 75 per cent by the State and 25 per cent by the county in which the highway is located, the State paying the entire cost in the first instance and collecting as a refund the 25 per cent from the county.

In order to aid the small towns, 15 per cent of the amount appropriated annually for State highway construction may be expended as follows: 5 per cent in towns of less than \$1,000,000 valuation, upon petition, the town making no contributions; 5 per cent in towns of less than \$1,000,000 valuation, the towns contributing an equal amount; and 5 per cent in towns of more than \$1,000,000 valuation, the towns contributing an equal amount, which amount must be in excess of its average annual appropriation for roads for the last five years.

When any road has been constructed or improved, in whole or in part, with money furnished by the Commonwealth, and is not laid out as a State highway, the city, town or county shall at all times keep it in good repair and condition. The department of public works shall from time to time notify the authorities in charge of the road whenever it is not so kept in condition, and shall specify what repairs or improvements are necessary, and said authorities shall forthwith proceed to make the specified repairs and improvements. If not made within 60 days (unless further time is allowed) the department may do the specified work and pay for it from any money available for the maintenance of State highways or from the part of the motor vehicle fees' fund available for work on through routes in the towns (20 per cent of the net). The amount of such expenditures shall be collected back in the form of State tax, the money collected to be available for use for the same purposes for which the money so expended was available, or for the repair and maintenance of State highways: but in towns of under \$1,000,000 valuation not more than \$50 a mile per year; in towns with a valuation of over \$1,000,000 and under \$2,000,000 not more than \$100 a mile a year, and in towns with over \$2,000,000 valuation not more than \$200 a mile a year shall be collected in any one year, but any balance shall be collected in succeeding years. The department may upon petition exempt any town from the whole or part of such payment if in its judgment said payment would prove to be an undue burden.

The State department of public works maintains the State highways at the expense of the State in the first instance, and the counties are required to repay to the State 25 per cent of the amount expended from taxation by the State for maintenance, except that part taken from motor vehicle fees; also the towns



are required to reimburse the State one-half the amount of such expenditures not exceeding \$50 a mile in towns under \$1,000,000 valuation, and not exceeding \$100 per mile in towns of from \$1,000,000 to \$2,000,000 valuation, not exceeding \$200 a mile in towns from \$2,000,000 to \$5,000,000 valuation, and in towns of over \$5,000,000 valuation not to exceed \$2,000 a mile in the aggregate nor exceeding \$500 a mile in any one year. The amount collected shall be credited to the appropriation for State highways and used again by the department. The department may upon petition exempt a town from the payment of any part of the expenditure for the repair of State highways.

The State road construction revenues are derived from taxation, usually authorized for five years, one-fifth of the amount authorized to be expended each year during the five-year period.

The appropriation is usually at the rate of \$1,000,000 per annum, but is dependent upon the annual action of the legislature. Of the automobile fees and fines, after deducting the expense of administering the automobile department, the balance is applied to the maintenance and reconstruction of State highways and State aid to towns in such proportion as may be determined by the legislature upon recommendation of the department. The net fees, fines, etc., in 1921, amounted to \$4,385,000. In addition, the legislature makes direct appropriations from time to time to meet special expenses and additional maintenance costs.

General Laws, chapter 81, provides for assistance by the State to towns of less than \$3,000,000 valuation on the basis of road mile valuation, that is, the valuation divided by miles of road. The towns have to appropriate \$12.50 per road mile where such valuation is under \$5,000, to \$125 where it is over \$40,000 and under \$50,000 per road mile. It figures out about \$3 per \$1,000 of valuation. The State may expend not to exceed \$50 per mile. In 1920, \$236,300 was appropriated by the State. Excellent results have been obtained in keeping the roads in fair shape in the poorer towns, although no reconstruction is attempted.

*Federal Aid.*—The total apportionment by the Federal Government, including the fiscal year 1921, is \$4,053,543. To date 47 projects have been approved, involving 169 miles of road and an obligation by the government of \$2,701,804. There are also three projects not yet approved covering five miles of road, of which the government's portion is \$76,000.

### Local Legislation

The local roads are under the boards of selectmen of the towns or under a superintendent of streets, or under direct road surveyors, as the towns from time to time determine. The county commissioners may, upon petition, lay out new roads or make

specific improvements, and may direct towns and cities to make such improvements.

### **Convict Labor**

By chapter 633 of the Acts of 1913 there was a provision for using prisoners in improving waste and unused land. In 1915 this act was amended so that the county commissioners could make arrangements with the officials of any city or town or with the State department to work prisoners on any highway, the prisoners to be in the custody of the sheriff of the county.

There were  $2\frac{1}{2}$  miles of macadam road built in 1918 under the provisions of this act, solely by the labor of prisoners.

### **Automobile Registration**

The law provides for annual registration with the division of highways, department of public works. The registration fees are as follows: Less than 30 h. p., \$10; 30 to 39 h. p., \$15; 40 to 49 h. p., \$20; 50 h. p. and over, \$25; motorcycles, \$5; commercial automobiles, trucks, and trailers, as follows: Capacity of 1 ton or less, \$10; capacity of 2 tons and over 1 ton, \$20; capacity of 3 tons and over 2 tons, \$30; capacity of 4 tons and over 3 tons, \$40; capacity of 5 tons and over 4 tons, \$50; for any capacity over 5 tons, \$50 for the first five tons and an additional amount of \$10 for each additional ton or part thereof; trailers, one-half of the above fees; dealers and manufacturers, \$25; and \$5 for each additional car over five demonstrated on the road; dealers and manufacturers' motorcycles only, \$10; operators, including owners, \$2, renewal fee \$2.

The net registration revenue shall be expended under the direction of the State highway commission for maintenance of State highways, provided that an amount not exceeding 20 per cent of such revenue may be expended by the commission for the repair, improvement and construction of local roads used as through routes. All fines are credited to the same fund as registration receipts.

### **Road Funds**

The sum of \$2,000,000 was appropriated for State highway construction during 1921. The department expects to have available for highway construction and maintenance this year about \$9,000,000 including money received from the Federal government and contributions from counties and towns. While it is not possible to give accurate figures, it is likely that the cities and towns will expend about \$20,000,000.

Sources, amounts and purposes of State road funds in 1921 were as follows: Appropriation for State highway construction, State paying the entire cost and collecting one-quarter back from



counties, \$2,000,000; net receipts from automobile fees, all of which is used for highway purposes, \$4,385,000; appropriations for equipment, \$375,000; appropriation for bridge maintenance, \$15,000; miscellaneous appropriations, \$2,225,000, including contributions by counties and towns, making a total of \$9,000,000.

### Progress Report

During the year 1921 contracts were awarded by the Department of Public Works, Division of Highways, for construction, reconstruction or resurfacing of highways in Massachusetts, amounting to approximately \$3,292,000. These contracts covered construction approximately as follows:

15.66 miles cement concrete.....	\$ 833,472.30
49.40 miles bituminous macadam.....	1,934,843.25
4.25 miles bituminous concrete.....	152,805.34
14.60 miles gravel .....	257,422.44
.91 miles water-bound macadam, oiled.....	15,279.92
Bridges and approaches.....	97,336.90
	<hr/>
	\$3,291,160.15

The cost of maintaining our 1,394 miles of State highway during the year was approximately \$1,200,000.

### State Highway Officials

*Department of Public Works.*—Commissioner of public works, Jno. N. Cole; associate commissioners, division of highways, Frank D. Kemp, Springfield; James W. Synan, Pittsfield; secretary, Frederick N. Wales; chief engineer, Arthur W. Dean.

Revised by A. W. Dean, chief engineer.

## MICHIGAN

### State Highway Legislation

The State highway commissioner is nominated and elected by the people at the same time and in the same manner as the justices of the supreme court. He is required to be a citizen of the State and may appoint two deputies, one of whom shall be a competent engineer skilled in road building, and such other assistants as may be necessary. His duties are to give instruction in road and bridge construction and maintenance, to collect statistics and distribute State reward funds or funds given to the State for such purposes by the United States Government or by individuals. He is required to give expert advice to the local authorities and is required to make a map of every township in the State showing the roads and their condition and location, kind and quantity of

road materials, etc. His decision is final as to whether a road merits State reward, and he may withhold any portion of the reward until the road has been thoroughly tested.

The construction and maintenance of the State trunk lines is under the direct supervision of the State highway commissioner. Counties, good roads districts and townships pay varying percentages of the cost. The percentages are determined from population, State equalized valuation and trunk line mileage, and range from 5 per cent to 25 per cent of cost of construction and from 10 per cent to 50 per cent of the cost of maintenance. All construction projects must be advertised by the State highway commissioner, but townships, good roads districts and counties may contract to do the work at a price below the lowest bid, if all bids are rejected. The State highway commissioner is also authorized to contract with the townships, good roads districts and counties for doing the maintenance work under his direction.

Whenever any township or board of county commissioners or good roads district commissioners have made arrangements to improve a mile or more of public road by constructing a sand-clay, gravel, stone-gravel, gravel-stone, macadam, concrete or brick road and ask for an allotment of State reward, and file with the State highway department a profile of the highway to be improved, and make application for plans and general specifications, the State highway commissioner shall furnish the plans and specifications and allot the funds from the State treasury as the State reward if, after completion, he finds the road to be up to the required standard. Each surveyed township is entitled to receive State reward on not more than 4 miles of road in any one fiscal year. The reward is allotted as follows:

a. Every mile of well-graded road, with grade not exceeding 6 per cent, except where found impracticable and a steeper grade is recommended after examination by the State highway commissioner, with not less than 20 feet between side ditches, properly drained, with travel track not less than 9 feet, made of a mixture of sand and clay or other material, shall merit, if approved by the State highway commissioner, a reward or aid from the State of 25 per cent of cost up to \$3,000 per mile.

b. Every mile of well-graded road having not to exceed 6 per cent grade, except where found impracticable and a steeper grade is recommended after examination by the State highway commissioner, width not less than 20 feet between ditches, well-drained, travel track not less than 9 feet, surface not less than 8 inches compacted gravel applied in not less than two courses, each rolled separately, shall merit, if approved by the State highway commissioner, a reward or State aid of 25 per cent of cost up to \$5,000 per mile.



c. Every mile of well-graded road having not to exceed 6 per cent grade, with not less than 20 feet between ditches, well drained, travel track not less than 9 feet and having a foundation not less than  $4\frac{1}{2}$  inches of crushed stone, slag or other material compacted, and top course of layer of gravel not less than  $3\frac{1}{2}$  inches, shall merit, if approved by the State highway commissioner, a reward or State aid of 25 per cent of cost up to \$5,000 per mile.

d. Every mile conforming to the above conditions as to grade, width, drainage, etc., and having a bottom course of gravel, slag or other material not less than  $4\frac{1}{2}$  inches thick after rolling and a top course of crushed stone not less than  $3\frac{1}{2}$  inches thick after rolling, shall merit, if approved, a reward or State aid of 25 per cent of cost up to \$5,000 per mile.

e. Every mile conforming to the foregoing as to width, grade, drainage, etc., and having a surface of well-compacted macadam not less than 7 inches thick laid in not less than two courses, each properly bonded, shall merit, if approved, a reward or State aid of 25 per cent of cost up to \$5,000 per mile.

f. Every mile conforming to the foregoing as to grade, drainage, etc., and having properly laid cement concrete or bituminous concrete not less than 6 inches in thickness, shall merit, if approved, a reward or State aid of 25 per cent of cost up to \$7,500 per mile.

g. Every mile conforming to the foregoing as to grade, drainage, etc., and consisting of a paving brick surface laid on gravel, sand, broken stone or slag, the quality of brick, manner of laying and kind of inspection employed to be made to comply with the specifications made by, or approved by the State highway commissioner, shall merit, if approved, a reward or State aid of 25 per cent of cost up to \$7,500 per mile.

Firm earth, gravel or macadam shoulders must be placed on each side of the concrete and brick 8-foot metal track.

Two or more townships may act jointly in the improvement of boundary line roads.

The State highway department is required to design, construct and maintain all bridges of 30 feet clear span and over on State trunk line roads, provided the county, township or good roads district agrees to construct at least 3 miles of road, including the bridge site. The State highway department is also authorized to contract with counties, good roads districts and townships for the construction and maintenance of all bridges of more than 30 feet clear span on State reward roads, provided at least 3 miles of State reward road have been built or funds have been provided to build 3 miles within one year.

The 1913 legislature passed what is known as "the trunk line highway act," which delineates certain highways leading from

town to town in the State, upon which townships and counties were entitled to double the State rewards mentioned above, when they built roads according to specifications drawn by the State highway department. The fixing of the location of these routes between towns, the preliminary surveys and the drafting of specifications was in the hands of the State highway department, while the construction of the roads was in the hands of the townships and counties through which they pass. The law provides that the total allowable mileage of trunk lines in any county may equal the number of surveyed townships multiplied by 3.

The 1915 legislature authorized the local township officials or, where the county road system had been adopted, the county highway officials and the State highway commissioner, to lay out additional trunk line mileage up to 3 miles per surveyed township.

The 1919 legislature authorized the State highway commissioner to lay out an additional 500 miles. This, added to the previous mileage, makes a total of about 6,000 miles of State trunk lines authorized.

The 1917 legislature passed a law assenting to the provisions of the Federal-aid act of Congress and providing the machinery for taking advantage of that law. The 1919 legislature amended it to make it correspond with the trunk line act so far as local payments are concerned and provided that proceeds from the sale of State bonds would be available to pay the State's portion of the cost of Federal-aid roads.

### **Local Legislation**

The commissioner of highways of each township has charge of township roads and the board of county road commissioners of each county adopting that system has charge of county roads.

An assessment district law provides that a petition signed by 60 per cent of the abutting property owners may be presented to the board of county road commissioners where the county road system is in force or to the State highway commissioner elsewhere for the improvement of a portion of a leading public wagon road. A portion of the cost is borne by the local assessment district and the remainder by the townships benefited or the county where the county road system is in force.

### **Bond Legislation**

In April, 1919, an amendment to the constitution was approved authorizing the legislature to provide for the issuance of bonds for road improvement in an amount not to exceed \$50,000,000, to be applied to road and bridge construction on the trunk-line system.



The township board of any organized township, upon petition of at least 25 freeholders thereof, may submit to an election the proposition of issuing bonds of the township in an amount not exceeding 5 per cent of the assessed valuation thereof, for improving the roads therein under the commissioner of highways subject to direction of the township board, a majority of the legal voters voting is necessary to authorize the bond issue. These bonds shall bear not to exceed 6 per cent interest and shall run not to exceed 25 years, and the tax shall be levied annually to meet the interest and principal as fast as they become due.

Counties that have adopted the county road system may issue bonds to pay for such improvements as the commissioners of highways decide to make in an amount not exceeding 3 per cent of the valuation of property assessable for this purpose. Before issuing these bonds, the county board of supervisors must order an election to decide on the issue. A majority of votes cast is required to authorize the bond issue. Bonds shall not be sold for less than part and shall run for not exceeding 20 years. The rate of interest and method of payment are not specified.

### **Convict Labor Laws**

County road officials may direct the employment of county prisoners confined for petty offenses upon the highways of the county.

The wardens of the State penitentiaries may, upon proper application from highway officials, put State prisoners to work in the same manner as county prisoners. State convicts may also be used in surface quarries and stone yards in preparing material to be used on the public highways.

### **Automobile Registration**

Automobiles are registered annually with the Secretary of State. The fees for steam and gasoline vehicles are 25 cents per h. p., plus 35 cents per 100 pounds weight. The fees for electric vehicles are \$1 per h. p., plus 35 cents per 100 pounds weight. One-half the money is returned to the counties for road purposes and half is paid into the State reward fund.

### **State Road Funds**

The State derives its revenue for State road purposes from two sources, namely, State bond issue and the motor-vehicle fund, ten million dollars being available each year from the bond issue and about three million dollars from the motor-vehicle fund.

For the fiscal year ending June 30, 1921, there was credited to the State highway department the sum of \$13,384,150, dis-

tributed as follows: Departmental administration, \$324,150; surveys, plans and preliminary work, \$60,000; State rewards, \$1,250,000; bridge construction and maintenance, \$400,000; maintenance of trunk line and Federal-aided roads, \$1,250,000; assessment district administration, revolving fund, \$100,000; State rewarded road maintenance, \$40,000; construction, \$10,000,000.

It is estimated that about \$22,000,000 was expended by the counties, townships and good roads districts of the State for the construction and maintenance of roads and bridges during the year.

### **Progress Report**

During the calendar year of 1921 approximately 780 miles of trunk-line and Federal-aided roads were placed under construction by the State, and approximately 930 miles of surfacing were completed during the year, of which 315 miles were pavement type. Also 800 miles of non-trunk-line roads were accepted for the payment of State reward.

Approximately 9,700 miles of road have been improved in Michigan as of January 1, 1922, this total including trunk-line, Federal-aid and State-reward roads.

Approximately \$19,000,000 was expended during the calendar year on trunk-line and Federal-aided construction by the State and approximately \$2,800,000 for State rewards. Thirty-three trunk-line bridges and sixteen non-trunk-line bridges were completed during the year, there being expended on such bridges and on others, the construction of which has been begun but not completed, approximately \$900,000.

### **State Highway Officials**

Frank F. Rogers, State highway commissioner; L. H. Neilsen and Leslie H. Belknap, deputy highway commissioners. Headquarters, Lansing, Michigan.

Revised by Leslie H. Belknap, deputy State highway commissioner.

## **MINNESOTA**

### **State Highway Legislation**

The present law provides for a State highway department of which the commissioner of highways is the chief officer. The commissioner is appointed by the governor for a term of two years, and is required to devote his entire time to the performance of his official duties. He must appoint as assistant commissioner of highways an experienced road builder and engineer, who has charge, under the supervision and control of the commissioner, of the technical work of the department. The necessary assistant



engineers and other persons to carry on the work in the department are also appointed by the commissioner of highways, who fixes the compensation of all employees.

The commissioner, his assistant and the assistant engineers are required to give advice and engineering services to other State departments as the governor may require. The engineers shall also make all necessary surveys, plans and specifications for construction and give direct supervision to all State road work under rules and regulations prescribed by the commissioner of highways.

Any county board may, with the consent of the commissioner of highways, designate any established road as a State-aid road and construct, improve and maintain the same under the regulations of the commissioner of highways. The State-aid road system embraces about 9,500 miles. The trunk highway system includes approximately 7,000 miles. The construction and maintenance of this system is under the direct control of the commissioner of highways. The total mileage of all roads in the State is approximately 100,000 miles.

With the exception of three large counties in the State, each county employs a highway engineer from a list furnished or approved by the State highway department.

Surveys and plans are made by the highway engineer and submitted to the commissioner of highways for approval. When such approval has been obtained the county board proceeds to do the work by contract or day labor under the supervision of the highway engineer, who acts under the rules and regulations of the commissioner of highways.

The financing of construction and maintenance work on State-aid roads is taken care of in the first instance by the county board and State aid is paid thereon up to the limit of the allotment to the county at the rate of 50 per cent of the cost of work for counties of over \$15,000,000 valuation, 60 per cent for counties of over \$10,000,000, 70 per cent for counties over \$5,000,000 and 80 per cent for counties having a valuation of less than \$5,000,000.

It is required that the highway engineer of the department make a report on completed work, which, if approved by the commissioner of highways, is certified to the State auditor, who issues the warrants for State aid. This applies to both construction and maintenance.

In case any county board fails or neglects to maintain any State-aid road, the commissioner of highways may cause it to be maintained with funds from the reserve maintenance fund, the amount so expended to be deducted from the next State-aid allotment to the county and credited to the reserve maintenance fund, or he may, after notice to the county board, revoke the designation of such improperly maintained State road.

### Local Legislation

Jurisdiction over local roads lies with county and town boards. County boards of commissioners consist of five members elected for terms of four years while town boards of commissioners consist of three members elected biennially for each township. Each town has from one to four road overseers, appointed by the town board, who have charge of the work under the board's supervision.

Counties are required to construct and maintain State roads and to construct county roads. To finance this work the county board is authorized to levy a tax of not to exceed 10 mills each year, to which is added the State aid. The county may purchase equipment and do its work by contract or by day labor.

County roads are laid out on petition of 24 or more freeholders, and roads established by judicial proceedings, or roads traveled six or more years without having been established by proceedings also become county roads.

Towns are required to construct town roads and to maintain county and town roads. Town roads are laid out on petition of eight or more voting freeholders. The electors may vote a tax on the town not exceeding 15 mills and subsequently the town board may, in case of emergency, levy an additional 5 mills, to be used for construction and improvement of town roads, by contract or day labor, as the board directs. There is also a compulsory tax of one mill, which forms the dragging fund, used only for dragging the town and county roads and for purchasing drags.

### Bond Legislation

The constitutional amendment adopted in November, 1920, provides for the issuance of bonds of the State not to exceed \$10,000,000 in any one year, and not to exceed \$75,000,000 outstanding at any one time. No bonds are to be issued under the provisions of this amendment except as authorized by the legislature. The 1921 legislature did not provide for the issuance of any bonds under this provision of the amendment.

On petition of fifty or more voting freeholders, and a majority vote at the subsequent referendum, the county board shall issue bonds of the county in such amount as will not, with existing indebtedness, make the total indebtedness of the county exceed 15 per cent of the taxable valuation of the county, the funds to be used for hard surfacing or otherwise permanently improving any established county road.

On petition of 15 or more voting freeholders of a town and a 60 per cent favorable vote at the town meeting, the town board shall issue bonds of the town, in amount not exceeding the cost of the proposed improvement and not exceeding, together with



outstanding indebtedness, 5 per cent of the assessed valuation of the town, for the purpose of improving any established highway in the town.

### **Convict Labor Laws**

No legislation provides for convict labor upon highways. They may be and are used for crushing stone on the prison grounds, for highway purposes as directed by the State commissioner of highways.

### **Automobile Registration**

Annual registration of motor vehicles with the Secretary of State is required, these being as follows: 2 per cent of the value of the vehicle, which shall be construed to mean the manufacturers' list price at the factory when the vehicle taxed was new. During the fourth and fifth years of vehicle life such list price is reduced 25 per cent. The value during subsequent years of the vehicle life is reduced 50 per cent.

Trucks and trailers engaged in commercial freighting, busses and carriers of passengers for higher and lower than seven (7) passenger seating capacity shall pay 25 per cent increase over the tax provided for trucks. The minimum fee for passenger vehicles under 2,000 pound weight is \$12, while the minimum fees on other passenger motor vehicles is \$15. The minimum fee on trucks and trailers of under 2-ton capacity is \$15, and the minimum fee on trucks and trailers of 2-ton or over 4-ton capacity is \$30. The minimum fee on trucks and trailers of 4-ton and over capacity is \$50. Motorcycles without side cars, \$5; motorcycles with side car additional, \$3.

### **Road Funds**

The State road and bridge fund is created by an annual tax levy of one mill on each dollar of taxable valuation, all money accruing from investments of the internal improvement land fund, 5 per cent from the sale of U. S. lands and proceeds from milk and cream testing licenses.

The commissioner of highways, State treasurer and State auditor acting as a board of allotment, shall annually apportion to the State road and bridge fund, first setting aside an amount not exceeding \$50,000 as a reserve maintenance fund. The remainder which annually approximates \$2,000,000, is allotted to all of the counties of the State with the legal limitation that no county shall receive less than 1 per cent nor more than 3 per cent of the fund. Twenty per cent of the allotments so made shall be set aside as aid for maintenance of State roads, but more than 20 per cent may, by resolution of the county board and approved by the commissioner of highways, be provided for such maintenance.

All of the funds received from motor vehicle license fees are credited to the trunk highway fund. One hundred and fifty thousand dollars of this fund is set aside for the expense of the highway department, after which 40 per cent of the fund is set aside for maintenance of the trunk highway system. From the remainder such sum as may be found necessary for the payment of interest and refundment purposes is deducted, and the balance, together with Federal aid received, is the amount available for construction by the highway department on trunk highways. During 1921 approximately \$5,700,000 was received from the auto license fees.

During 1921 the counties expended for road construction approximately \$14,426,000, of which \$7,662,000 was expended by them on the trunk highway system, the balance being spent on the State-aid road system. In addition to this amount there was spent by the highway department on trunk highway construction \$2,670,000. It is probable that the 1922 expenditures by the counties will approximate the amount spent during 1921. The trunk highway expenditure by the State will be approximately \$5,000,000.

### Progress Report

During the year 1921 the following highway expenditures were made under the supervision of the State highway department:

<i>County Contracts</i>		
1,517.5 miles	grading.....	\$ 5,944,797.08
949.6 miles	gravel surfacing.....	2,427,339.28
85.76 miles	pavement construction.....	3,259,060.08
	clearing and grubbing.....	306,137.36
	hand ditching.....	130,034.11
248,230 feet	guard rail.....	146,677.17
528,405 feet	tile drain.....	272,478.88
196,004 feet	portable culverts.....	356,069.61
701 feet	Monolithic culverts.....	563,936.01
105 feet	bridges.....	1,015,658.51
	miscellaneous.....	4,245.00
		<hr/> \$14,426,433.09

<i>State Contracts</i>		
272.7 miles	grading.....	\$1,110,234.28
144.3 miles	gravel surfacing.....	529,766.76
29.8 miles	pavement construction.....	981,601.87
	clearing and grubbing.....	24,893.48
	hand ditching.....	4,687.87
	special plowing.....	149.74
8,232 feet	guard rail.....	9,344.21
	gutters.....	91.42
	retaining.....	17.33
	catch basins.....	403.23
	miscellaneous.....	9,387.91
		<hr/> \$2,670,578.10



All of the State contracts and approximately 50 per cent of the county contracts were for construction on the trunk highway system.

### **Maintenance**

During 1921 the counties maintained 9,551 miles of State-aid roads under the direction of the State highway department at a cost of \$1,551,620, and the highway department maintained 6,900 miles of trunk highways at a cost of \$2,224,227. The funds for the maintenance of the State-aid roads are derived from county levies and State-aid, while funds for the maintenance of the trunk highways are derived from motor vehicle license fees.

### **State Highway Officials**

Charles M. Babcock, commissioner of highways; John H. Mullen, first assistant commissioner of highways and chief engineer; J. T. Ellison, chief bridge engineer; O. L. Kipp, construction engineer; W. F. Rosenwald, maintenance engineer; S. C. Notestein, chief clerk.

Revised by O. L. Kipp, construction engineer, St. Paul, Minn.

## **MISSISSIPPI**

### **State Highway Legislation**

The State highway commission is composed of eight members, one from each congressional district. These commissioners are elected by the people and hold office for a term of four years.

The highway commission appoints a State highway engineer and the commission, with the engineer, constitute the State highway department.

The State highway engineer is required to plan improvement of such main roads, with their bridges, as will form a connected system of highways throughout the State, and to report in full to the legislature in 1922. He has charge of the construction of roads built in coöperation with the Federal government under the Federal highways act. Funds to meet Federal aid are raised by the counties.

The total mileage of roads in the State is 55,000. The mileage included in the proposed State system is 4,500. The mileage of the State system that is now improved is approximately 3,000.

### **Local Legislation**

Jurisdiction over all roads in a county lies in its board of supervisors. Each county is divided into five supervisors' districts, each of which may carry on its road work under the direction of three commissioners appointed by the board of supervisors. The

county board may also place a county road commissioner in charge of the county roads or any part of them. Road districts containing at least 10 square miles may be formed to build roads under the direction of three road commissioners appointed for four years. An entire county may be organized as a road district. The district commissioners are authorized to do work by contract of day labor. District road systems may include street municipalities. A county board may require adjoining road districts to connect their road systems.

The total amount of State funds for 1921 was the amount of the automobile license tax, approximately \$660,000. A like amount is estimated for 1922. This is in addition to the money furnished by the counties in order to secure Federal aid.

### **Bond Legislation**

The general bonding law of the State providing for the improvements of roads in one or more supervisor's districts contains a number of interesting, sound and business-like features, namely:

1. Bonds may be issued by boards of county supervisors for a county or district on petition of 20 per cent of the qualified electors, provided the issue is not petitioned against by an equal percentage of electors, in which event an election must be held, when a majority vote decides the question.

2. The bonds outstanding must not exceed 10 per cent of the assessed valuation of property in the county or district.

3. The bonds must be paid off in annual installments between the tenth and twenty-fifth year from the date of issue.

4. A special tax must be levied annually for the payment of interest and principal, and the proceeds can be used for no other purpose.

5. A special tax of at least 1 mill must be levied for the maintenance of the road.

### **Convict Labor**

There is no general convict labor law in reference to highways. Most convicts are employed upon State farms. The superintendent of the penitentiary is authorized to improve and maintain roads from each convict farm in the State for a distance of five miles out from said farms.

In four counties, convicts between the ages of eighteen and fifty sentenced to the farms may be required to work fifteen days on the roads.

### **Automobile Registration**

Motor vehicles are registered annually with the State auditor of public accounts through the county auditor. The fee for passenger cars is 50 cents per horsepower; for electrics, \$15, and



for commercial vehicles is as follows: 1 ton or less, \$10; 1½ tons, \$15; 2 tons, \$30; 2½ tons, \$35; 3 tons, \$55; 3½ tons, \$75; 4 tons, \$115; 4½ tons, \$155; 5 tons, \$200; 6 tons, \$250; for more than 6 tons capacity, \$75 for each additional ton not to exceed \$300; motorcycles, \$10.

The fees are collected by the regular tax collector of each county, the State auditor of public accounts being required to furnish him with a supply of licenses. The receipts from registrations are paid to the State treasurer, who credits one-half of the amount received from each county to that county's highway fund and the other half to the fund of the congressional district in which the county is located. The amount to the credit of the county highway fund is spent by the county under the supervision of the State highway department. The congressional district fund may be spent in any county or counties situated in the district, but under the direction of the State highway department.

### **Road Funds**

No State funds except those above referred to are available for road construction and maintenance in Mississippi. The highway department is supported, however, by an appropriation of \$100,000 by the legislature.

### **State Highway Officials**

The State Highway Commission: J. M. McBeath, chairman, Meridian; W. T. Denman, secretary, McComb City; and D. W. Robbins, Tupelo. State highway engineer, H. C. Dietzer, Jackson; J. C. Roberts, Cleveland; S. W. Mullens, Holly Springs; W. A. Boone, Pontotoc; Fred W. Smith, Poplarville; R. H. Henry, Jackson.

Approved by H. C. Dietzer.

## **MISSOURI**

### **State Highway Legislation**

At the general election in 1920 Missouri overwhelmingly carried Constitutional Amendment No. 6 authorizing the issuance of sixty million dollars for the construction of hard surfaced roads, and as a result the 51st General Assembly met in special session in 1921 and passed what was known as the Centennial Road Law.

This law calls for a bi-partisan commission of four members appointed by the governor with the consent of the Senate. The first four are appointed, one for a term of two years, one for a term of four years, one for a term of six years, and one for a term of eight years; all reappointments to be for terms of six years.

The State highway commission appoints a State highway engineer, a secretary of the commission and a legal representative. All other employees are appointed by the State highway engineer with the approval of the State Highway Commission. The salaries of members of the commission are fixed at \$10.00 per day and expenses. The State highway engineer's salary is limited to \$7,500, assistant State highway engineer and attorney each \$3,600 per year, division engineers, heads of departments and secretary of the commission, receive not over \$3,000 per year, and for other employees the rate is fixed by the commission.

The law also lays out a State system of roads reaching into each of the several counties and comprising approximately 7,700 miles. The law provides that all roads shall be at least of a type as good or better than properly bound gravel roads, and shall not cost on an average of less than \$6,000 per mile. The allotment of money for different counties is made on a basis of \$6,000 per mile and 1,500 miles of road were set out to be constructed of a higher type. These roads are to be selected by the commission and to connect the populous centers of the State.

The present law, known as the McCullough-Morgan law, remains in force until the end of 1922, or until such time as all projects contemplated have been constructed or provided for. This law provides for the expenditure of \$1,200 per mile for at least 50 miles of road in each county, to be used for grading and culverts up to 20-foot span. If found that the \$1,200 will not properly grade and construct culverts, the board is authorized to allot the money due the county on a smaller mileage. The \$1,200 per mile can also be applied on Federal-aid jobs, in which event the State pays \$600 to match the Federal government's \$600, the local subdivisions putting up one-half the money required above the \$1,200 per mile, which is in turn matched by Federal aid.

### Local Legislation

Road administration in the counties is in the hands of the county court, which consists of three county judges. The county court appoints, if it desires, a county highway engineer, who has general supervision over all the roads and bridge work in the county. The surveyor of the county, which is a constitutional office, is elected by the people and is ex-officio county highway engineer when the court appoints no regular county highway engineer.

In the counties not operating under township organization, the county is divided into road districts of not less than 9 miles or more than one municipal township in area and the county court appoints a road overseer for each district. These overseers are responsible to the county highway engineer.



Out of 114 counties in the State 22 have adopted township organization, under which the township officers handle the road work and appoint their own overseers. At the head of the township organization is the township board, consisting of a trustee and two other members. There is also an assessor and collector, justice of the peace and constable. Each road overseer in a township organization has a district in the township.

County and township road and bridge funds are derived from a tax of not less than 10 nor more than 20 cents on each \$100 of assessed valuation and from a poll tax of \$4 payable in cash or labor.

Special road district may be authorized by the county courts. The affairs of such districts are administered by a board selected by joint action of the county court and the municipal council of the town, required to be in each district so authorized. This board may levy taxes, issue bonds, enter into contracts, etc., and perform the various functions connected with road improvement and maintenance in about the same manner as the county and township organization.

### Road Bond Laws

The road bond law authorizing sixty million dollars of bonds carried at the general election in 1920 and at a special session of the legislature in 1921, a law was enacted authorizing the issuance of these bonds, of which ten million may be issued on or after the first of March, 1922, provided all money necessary to complete the projects under the McCullough-Morgan law is available or in the State treasury. The law authorizes the issuance after 1922 of five million dollars per year until the entire sixty million has been authorized.

County, township or special road district bonds have been voted and issued of approximately twenty million dollars in addition to the State-wide bond issue. Two hundred taxpaying citizens of a county petition the county court calling for a bond election. It takes, however, a two-thirds majority voting to authorize an issue of bonds in a county, in special road districts and counties under township organization.

County bonds cannot exceed 10 per cent, including the existing indebtedness of the assessed valuation of the taxable property two years previous to the voting of the bonds, and bear not to exceed 5 per cent interest and must mature within twenty years. The principal, sinking fund and interest of these bonds is paid by a tax levied for this purpose.

Special road district and township bonds bear not to exceed 6 per cent interest, become due in not exceeding 15 annual installments, the first of which shall become due not later than two years after the date of the bonds.

### Convict Labor Laws

The State prison board may cause inmates of the State penitentiary to work on State highways and on request of the various county courts may detail convicts to work on county roads. All expense incurred in connection with the transportation, guarding, and subsistence of such prisoners, and the supplying of proper equipment therefor is paid from State funds.

### Automobile Registration

Motor vehicles are registered annually with the Secretary of State. Under the new law passed by the special session of the legislature in 1921 all car owners have to register with the Secretary of State and pay a fee of \$1 for registration fee before they can secure their license tags. The rate on passenger cars is as follows: Less than 12 h. p., \$5; 12 to 24, \$7; 24 to 36, \$11; 36 to 48, \$15; 48 to 60, \$17; 60 to 72, \$21; 72 and more, \$25; motorcycles, \$4; motortricycles, \$5. For commercial motor vehicles having a capacity of less than 2 tons the rate is \$7; 2 to 5 tons, \$12; 5 to 6 tons, \$18; 6 to 7 tons, \$20; 7 to 8 tons, \$24, and for every ton or major fraction thereof in excess of 8 tons, \$10 per ton.

For trailers the rate is one-half of that provided for commercial motor vehicles and for each semi-trailer, one-fourth.

One dollar of each automobile license fee and the one dollar registration fee goes into a fund to be known as a maintenance fund for State roads.

### Road Funds

The road funds of the State are derived from automobile registration fees, the sale of option stamps, corporation tax fees, etc., which constitute the State road fund and are paid into the general treasury of the State, but must be appropriated by the legislature before they can be expended.

At the regular session of the legislature in 1921 there was appropriated the sum of sixteen million dollars for the years 1921 and 1922, to meet the Federal-aid funds allotted to the State, and to be used in matching the State's part of the McCullough-Morgan money.

This appropriation will hold and remain in full force until the enactments of the McCullough-Morgan law are fulfilled and until State bonds have been issued for road purposes.

The sum of \$400,000 was provided for the same period to defray the expenses of dragging the inter-county seat highway system.

For the same period \$398,000 was appropriated for the support of the State highway department.



### Progress Report

On January 1, 1922, the State had under construction 150 State and Federal-aid projects, the mileage of which amounted to 911, contract price of \$12,300,000, on which there has been spent \$7,160,000, and completed 455 miles.

It also had completed on January 1, 30 projects, totaling 143 miles, contract price \$1,385,000.

In addition to the amount completed and under construction there are in various stages of completion plans for approximately 150 more projects, the estimates on which will probably be \$10,000,000.

### State Highway Officials

Missouri State Highway Commission: Theodore Gary, chairman; S. S. Connett, vice-chairman; Murray Carleton and C. D. Matthews, members. H. A. Buehler, ex-officio member.

A. W. Graham, chief engineer; Carl W. Brown, first assistant engineer; E. S. Austin, secretary; Kirk McFarland, construction engineer; M. M. DeVorkin, assistant construction engineer; Chester D. Mann, bridge engineer; C. P. Owens, chief of surveys and plans; A. C. Lingley, M. J. Hanick, S. M. Rudder, H. D. Griffith, H. P. Mobberly, M. S. Murray, division engineers.

Revised by C. W. Brown, Jefferson City. Mo.

## MONTANA

### State Highway Legislation

The 1921 legislature amended the former State highway act, to provide for a State highway commissioner at an annual salary of \$6,000, to serve for a term of four years, and two assistant commissioners at a per diem of \$10, who serve for a term of three years each. The commissioners are appointed by the governor, and may be removed by him at any time for cause.

There are approximately 67,100 miles of rural roads in the State, of which about 7,800 miles are embraced in the State system. Construction of State highways is under the direction and supervision of the commission. The administrative and pre-construction engineering expense is borne by the State, while the cost of construction of these roads is borne by Federal and local funds.

The total mileage of the State highway system completed or under contract on January 1, 1922, amounted to 734 miles. The commission selects the roads deemed of sufficient importance to entitle them to be designated as State highways. The commission may divide the roads into two classes; one of primary importance, to constitute the interstate system, and the other of secondary importance, to constitute the intrastate or intercounty system.

The surveys, plans, specifications and estimates are made by the commission and all contracts for the construction of State highways are let by the State highway commission.

### **Local Legislation**

Jurisdiction over local roads vests in boards of county commissioners consisting of three members, one of whom is elected each two years for a term of six years. They divide the counties into districts and appoint one or more overseers in each. Special bridge and road districts may be created by election.

Road taxes, not less than 2 mills nor more than 5 mills for each county, are levied and collected by the county boards.

### **Bond Legislation**

County commissioners may issue bonds for the improvement of State or main highways when authorized by a majority of the electors. The indebtedness of the county is limited to 5 per cent of the assessed valuation. Bonds issued for a special road improvement district must be paid in 10 years from the date of issue.

### **Automobile Registration**

Automobiles are registered annually with the Secretary of State. The schedule of fees is as follows: Motor vehicles other than motor trucks, up to 23 h. p., \$7.50; from 23 to 37 h. p., \$15; over 37 h. p., \$22.50; motor trucks not over 1-ton capacity, \$10; over 1 ton and less than 2 tons, \$22.50; over 2 tons and not over 3 tons, \$37.50; over 3 tons, \$60.

### **Road Funds**

The State highway fund is derived from the moneys collected by the Secretary of State for motor vehicle licenses. After the expense of collecting fees and administering registration of motor vehicles has been deducted by the Secretary of State, from the total amount of fees collected, 50 per cent of the remainder is credited by the State treasurer to the State highway fund and 50 per cent is returned to the counties from which it was collected, where it is placed to the credit of the general road fund. All of the amount credited to the State highway fund is expended at the discretion of the State highway commission. The gross receipts from the motor vehicle fund to November 30, 1921, amounted to \$593,231, with an estimated administrative expense for collecting fees and registering motor vehicles of \$50,000.

The commission is not allowed to expend any State funds in the corporate limits of cities or towns. The funds expended for



construction including engineering and supervision, from December 1, 1920, to November 30, 1921, amounted to \$6,525,000, of which approximately 40 per cent was derived from the Federal government and 60 per cent was supplied by the various counties within which the work was done. It is estimated that there will be available for expenditure during 1922 the sum of \$2,000,000, of which \$1,000,000 will be derived from the Federal government and \$1,000,000 will be supplied by the various counties. The regular road funds of the several counties of the State aggregate approximately \$4,000,000 per annum.

### **Progress Report**

During the year of 1921, 21 road projects and 31 bridges were placed under contract, comprising 68 miles of earth roads, 172 miles of gravel roads and 6½ miles of paved roads at a total estimated cost of \$1,483,000, exclusive of engineering. There was carried over from 1920 unfinished contracts, involving \$2,375,000 of work to be completed, equivalent to 270 miles. At the end of 1921 there had been completed a total of 133 miles of earth roads, 336 miles of gravel roads, 28 miles of paved roads and 31 bridges, at a total cost of \$5,376,693, exclusive of engineering. In addition to this, there had been completed on unfinished projects under construction, an equivalent of 132 miles of various types of road, at a cost of \$1,164,267, exclusive of engineering.

The program for 1922 construction involves 212 miles of road at an estimated cost of \$2,000,000.

### **Maintenance**

During the year 1921, this department supervised the maintenance of 166 miles of road at a cost of \$6,832. It is estimated that in 1922, there will be available for maintenance of completed State highways the sum of \$100,000. All roads are maintained by the county or with funds derived from the county.

### **State Highway Officials**

The State Highway Commission consists of George W. Lanstrum, State highway commissioner; H. A. Templeton and H. C. Good, assistant commissioners, and John N. Edy, chief engineer. Approved by John N. Edy, Helena, Mont.

## **NEBRASKA**

### **State Highway Legislation**

State highway work is now under the jurisdiction of the department of public works which is presided over by a secretary who is appointed by the governor and confirmed by the State Senate.

His term of office is two years and he receives a salary of \$5,000 per year.

The State highway system consists of eighty-eight routes with a total mileage of approximately 4,500. The construction and maintenance of this system is under the control of the department of public works. The cost of construction is paid for from the State and Federal road funds, each county receiving from that fund a certain allotted amount.

The maintenance of the system is under the direct control of the county officials, the State department having authority to approve claims and direct the work as to methods and costs.

There are approximately 80,000 miles of roads in the State; and under the new Federal highway act, the original State system of 4,500 miles will be increased to approximately 5,600 miles, 2,100 miles of which will be on the primary and 3,500 on the secondary system.

The State also aids the counties in the construction of bridges across streams 100 feet or more in width to the extent of paying one-half the cost. Such bridges are built under the direct supervision of the department of public works. The contracts for this work are let jointly by the county officials and the State department. The cost of maintenance is paid equally by the State and counties if in excess of \$100 per bridge per annum. If the repairs do not reach this amount, the entire maintenance cost is borne by the county.

Federal aid projects must be approved by the county board of the county in which the project is located before they can be submitted by the State to the U. S. bureau of roads for final approval.

Nebraska's share of the first Federal aid appropriation was \$1,599,850. The State legislature in April, 1917, accepted all the provisions of the Federal aid law and appropriated \$640,000 for the biennium of 1917-18 and authorized the State board of irrigation to cooperate with county officials and lay out a system of roads which was to be presented to the Department of Agriculture before Federal money could be received.

This system was decided upon by the State highway department and county officials, and was approved by the State legislature and the Federal government.

During the 1919 session of the State legislature, Congress appropriated an additional \$200,000,000 of Federal aid, bringing Nebraska's total apportionment up to \$5,866,761.66. The legislature then made an appropriation of \$3,093,262, and in 1921 appropriated an additional \$2,693,797.81, making a total, appropriated by the State, of \$5,996,012.39.



### Local Legislation

Road work in the counties is carried on under the direction of the board of county commissioners or supervisors. Each county is required to appoint a county highway commissioner who takes care of county road and bridge work and is in direct charge of the maintenance of the State highway system. The maintenance of the State system is an important part of the county officials' duties. This work is paid for from the fees derived from the registration of motor vehicles.  $3\frac{1}{2}$  per cent of the total collections are sent in by the county treasurer to the State for the administration of the law and the supervising work of the State division engineers. From the balance, an amount is taken which is deemed adequate by the division engineer and the county board for the proper maintenance of the State system. This amount is put into what is known as a State highway fund and remains in the county treasurer's office. The remaining amount is put into the county road dragging fund and may be used for dragging county roads not on the State highway system. In case the county does not adequately maintain the State system as directed by the department of public works, the department may, after due notice take over the maintenance work, and have access to all the money in the State highway fund as well as equipment which has been purchased for the maintenance work.

County roads and bridges are paid for from tax levies made by the county officials. In 1921 it is estimated that the amount spent for road work by the counties on mileage not included in the State system was in the neighborhood of one and one-half million dollars, and the amount spent for county bridge work was approximately two million dollars.

### Bond Legislation

Any township, county or precinct desiring to issue bonds or to make a special levy to construct or aid in construction of a highway may proceed to vote upon question or make a special levy not to exceed 5 mills for such purpose.

Any county, township, precinct, city or village may issue bonds to construct a highway bridge across any boundary river of the State, on an affirmative vote of three-fifths of the voters at a special election. The amount of bonds must not exceed 10 per cent of the valuation. In any county, township, precinct, city or village which has made donations to railroads or other internal improvements, a two-thirds vote shall be required for issuing such bonds. The interest shall not exceed 7 per cent. An annual tax is levied for interest and sinking fund. The term of the bond is not designated.

Similar provisions are made for purchasing private bridges within any township or across any river bounding a township. Any county or city in the State is authorized to issue bonds for internal improvement and it appears that such improvements include highways.

### **Convict Labor Laws**

The department of public works may acquire land and equipment or road building materials and may enter into contract with the board of commissioners of State institutions for the employment of convict labor in such work and for road building purposes.

### **Automobile Registration**

Annual registration fees are \$5 for motorcycles, \$10 for automobiles for the first 2,000 pounds and 50 cents for each additional 100 pounds. For trucks and cars equipped to carry more than seven passengers, the fee is based on the weight of trucks and cars when loaded to capacity, each passenger being rated at 150 pounds.

Registration fees are paid to the county treasurer and with the exception of  $3\frac{1}{2}$  per cent, is retained by the county.

### **Road Funds**

The State derives its revenue for State road and bridge purposes from a tax on the actual value of all the assessable property in the State. Three mills is levied for the support of the entire State government, out of which, approximately 11 per cent is appropriated for road and bridge work. In 1921, this amounted to \$1,066,000. It is assumed that the same amount will be raised in 1922. During 1921, the State spent for construction work on the State highway system, from State and Federal funds, about \$2,000,000.

In 1921 there was appropriated for State aid bridge work \$350,000. This must be met by an equal amount from the counties so that for 1921-22, \$700,000 will be spent on Nebraska bridges.

Automobile registrations for 1921 amounted to \$2,819,629, approximately three-fourths of which was spent for the maintenance of the State highway system, the balance being expended for maintenance of the county systems.

### **Progress Report**

From 1918 to 1921 a total of 1906 miles of road have been improved as indicated below:



	1918	1919	1920	1921	
Earth roads .....	274.28	711.47	319.88	350.1	1655.73
Surfaced roads .....	26.62	101.74	74.33	47.76	250.45
Total .....					1906.18

The gravel roads constructed during 1921 cost \$304,003; while the earth roads cost \$1,522,381.

Principal Officers of the Department of Public Works: Samuel R. McKelvie, governor; Geo. E. Johnson, secretary and State engineer; Geo. K. Leonard, assistant secretary; Robert H. Willis, chief, bureau of irrigation; E. H. Morey, chief, bureau of roads and bridges; A. W. Moffitt, superintendent, division of road equipment. There are also 10 division engineers.

J. R. Carnahan, office engineer; Mabel Tracy, chief clerk, motor vehicle department.

Revised by Geo. K. Leonard, Lincoln, Nebraska.

## NEVADA

### State Highway Legislation

The State highway department consists of a board of directors of three members, who have authority to appoint the State highway engineer, who in turn appoints other engineers and employees as may be necessary.

The system of State highways comprises ten separate routes of about 2,250 miles to which State and local funds are applied and of which 207 miles have been improved or contracted for. The total road mileage of the State on which the Federal-aid seven per cent system is based is 22,000.

The 1917 legislature appropriated \$40,000 and levied a seven-tenths mill tax for the State and a similar tax for the counties. This tax was increased to 1 mill in each case for all succeeding years. The proceeds from the mill State tax constitute the State highway fund to be expended solely under the jurisdiction of the State highway department and the 1 mill county fund constitutes the county State highway fund to be expended on the State system in each county in which any portion of the State system is located and under the direction of the State highway department through bills approved by the county boards of commissioners in the respective counties.

The 1917 act accepts and assents to the provisions of the Federal-aid act and gives the board of directors full power to secure and make use of the State's allotment of Federal aid. Federal aid allotted to November, 1916-21, inclusive, amounts to approximately \$3,527,276, to which should be added \$191,000 allotted un-

der section 8 of the same act, making a total of about \$3,718,276.18. All State highway projects thus far undertaken, 37 in number, have included Federal aid. The Federal aid on these up to the present time, amounts to \$1,864,251.

### **Local Legislation**

Local roads are under the jurisdiction of the boards of county commissioners of from three to five in each county. Commissioners divide the counties into districts and appoint one or more overseers for each. The board may appoint a county road supervisor as its executive official or on petition may appoint a board consisting of from one to three road commissioners for each district. County road taxes may be levied at rates not exceeding one-fourth of one per cent of the valuation. On petition a special tax may be levied at a rate not to exceed 30 cents on the \$100 of valuation. A poll tax at the rate of \$3 per capita is also levied.

The county expenditures on road maintenance and improvement for 1921 aggregated approximately \$600,000, according to records available and it is estimated that this same expenditure for 1922 will approximate the same amount.

### **Bond Legislation**

The legislature of 1919 authorizes a State bond issue of \$1,000,000 for State roads and to meet Federal aid. The interest and principal on these bonds are to be taken care of by the receipts from automobile fees. The legislature also authorized county bond issues as follows: Humboldt, \$75,000; Pershing, \$75,000; Washoe, \$650,000; White Pine, \$150,000; Churchill, \$100,000; Clark, \$75,000; Elko, \$150,000; Mineral, \$30,000; Esmeralda, \$15,000; Lyon, \$50,000; Douglas, \$150,000. Total, \$1,520,000. These bonds are authorized in order to permit the counties to take advantage of the Federal aid, as the State funds are not sufficient for that purpose.

On a majority vote of the electors of any county, the board of county commissioners may issue bonds for road and bridge purposes. The amount of these bonds must not exceed 3 per cent of the assessed valuation of the real and personal property in the county, and bear not to exceed 6 per cent interest. An annual tax is levied by the county by which to pay the interest and retire the bonds in equal amounts after the third year.

### **Convict Labor Laws**

State prisoners may be employed in the construction and maintenance of State highways under the direction of the State highway engineer and the warden of the State prison. The board of



prison commissioners has power to pay convicts 25 cents per day for work faithfully performed and to grant time allowance for good behavior. Convicts so detailed are not required to wear stripes. Prisoners under death sentence are not detailed to road work, and no convicts are detailed except with their consent.

### Automobile Registration

Automobiles are registered annually with the Secretary of State. The passenger cars pay a fee of 35 cents per 100 lbs. for car weight plus 125 lbs. for each passenger, and trucks 35 cents per 100 lbs. including body weight plus load capacity. Manufacturers' or dealers' license fee, \$20 each.

The fees are paid into the State treasury to the credit of the State highway bond redemption fund for the purpose of retiring the \$1,000,000 State road bond issue, except those received from counties not included in the State highway system, which are refunded to the counties and credited to their road repair funds.

### Road Funds

Receipts to the State highway fund—1 mill tax—amount to approximately \$210,000 per year. The County-State highway fund amounts to approximately \$175,000 per year. Both these funds are expended under the direct control of the State highway department. The general road and bridge fund of all counties, which is directly under the control of the board of county commissioners of each county, amounts to approximately \$800,000 for the entire State per year.

The 1921 expenditure of the State highway department for road improvement amounted to the sum of \$1,460,379.49. The revenue for this expenditure came from the following sources:

Federal Aid .....	\$566,590.63
County Aid .....	439,976.51
Lincoln Highway Association.....	10,039.81
Tax Income to State.....	203,961.89
Sale of State Bonds.....	325,000.00
State Racing Commission Income.....	11,998.61
Miscellaneous Sales and Revenues.....	80,192.07
Total .....	\$1,637,759.52

The 1922 program of the department is estimated at \$1,800,000.

### Progress Report

The construction program for 1921 comprised 25 miles of grading, 250 miles of gravel surfacing, 40 miles of concrete paving, and the construction of reinforced concrete bridges of a total length of 320 feet, at an estimated cost of \$2,600,000.

The 1921 program completed by the department consisted of 14.2 miles of concrete, 22.1 miles of gravel, 3.2 miles of grading; 2 concrete, 1 wooden and 1 one thousand foot steel bridges—in addition to the completion of graded and graveled roads on a few contracts in that year not completed in the 1920 program.

The tentative construction program for 1922 comprises 22.8 miles of concrete, 179 miles of gravel surfacing, 29 miles of gravel surfacing of projects graded during previous years.

### **Maintenance**

During the year 1921 the department maintained approximately 175 miles of roads which were constructed since the beginning of operations by the State highway department at a total cost of \$33,601.

Two stretches of road have been maintained by the patrol system. One stretch is an abandoned railroad grade of 80 miles requiring constant attention by reason of the heavy traffic. The other road on which the patrol system is used is a 25-mile stretch in the mountains, which, due to the steep grades and sharp curves, soon becomes in a very poor condition without maintenance.

No maintenance work was done during the year on roads not improved as part of the State highway system.

### **State Highway Officials**

Board of directors: James M. Leonard, chairman; George A. Campbell and W. H. Johnston, directors; George W. Borden, State highway engineer.

Revised by George W. Borden, State highway engineer.

## **NEW HAMPSHIRE**

### **State Highway Legislation**

In 1915 the legislature abolished the office of the State engineer and created a State highway department, in charge of a highway commissioner appointed by the governor for five years. He has charge of the location, construction and maintenance of roads built in part or wholly with State funds. All technical features of the work, the award of contracts and the supervision and construction are under his control, but the taking of lands or materials by eminent domain is under the governor and council. Appeals from his decisions may be taken to the governor.

In addition to three original north and south trunk lines there have been designated and laid out 29 cross State roads, and the towns and cities through which these roads pass are entitled to both State aid and trunk line aid. The State contributes toward



the trunk line work one-half the cost and such further sums in towns unable to pay one-half the cost as the highway commissioner considers equitable. The work is done by contract or by local authorities under the direction of the State highway department. If a city or town neglects or refuses to raise its proportionate part of the cost of construction of a trunk line road within the town, the State may do the work and assess the town for its proportionate part, charging the amount to the State tax of that town. This charge is not to exceed 0.25 to 1 per cent of the town valuation in any one year.

Aside from the trunk line aid the State grants aid to towns (townships) on the following plan: Each town, out of the money raised for highway purposes, shall set aside the following amount for the improvement of its highways under the supervision of the State engineer: Towns having a valuation of less than \$2,000,000, \$1 on each \$1,000 valuation; towns of \$2,000,000 and less than \$3,000,000 valuation, 75 cents on each \$1,000 valuation; towns of \$3,000,000 and less than \$5,000,000 valuation, 50 cents on each \$1,000 valuation; towns of \$5,000,000 and less than \$15,000,000 valuation, 33 1/3 cents on each \$1,000 valuation; towns from \$15,000,000 valuation and upward, 25 cents on each \$1,000 valuation; counties in which are located unincorporated towns, \$1 on each \$1,000 valuation.

If a town desires State aid for permanent improvement in addition to the improvement provided by this method, it must raise an additional amount equal to 50 per cent of this sum before its application for State aid. It will receive for each additional dollar raised the following amounts: Towns having a valuation of less than \$100,000, \$3 for each \$1 so set apart; \$100,000 and less than \$150,000, \$1.25 for each \$1; \$250,000 and less than \$500,000, 60 cents for each \$1; \$500,000 and less than \$1,000,000, 40 cents for each \$1; \$1,000,000 and less than \$3,000,000, 25 cents for each \$1; \$3,000,000 and upward, 20 cents for each \$1. The amounts thus set aside by the towns, respectively, constitute a joint fund for permanent improvement.

The State road funds are provided by direct appropriation and the funds for both trunk line and State aid are met by a current appropriation.

### **Local Legislation**

County commissioners have jurisdiction over roads in unincorporated places and selectmen over town roads. A part of the property road tax is rebated to persons complying with the wide tire laws.

### **Automobile Registration**

The law provides for annual registration with the Commissioner of Motor Vehicles. The schedule of fees is as follows:

60c per 100 pounds gross weight of vehicle and load, if equipped with pneumatic tires; 85c if equipped with solid rubber tires, and \$1.00 if equipped with metal tires. Minimum fee for passenger car registration, \$15. Minimum fee for motor truck registration, \$20. Fee for registration of trailer or semi-trailer: 50c per 100 pounds gross weight of vehicle and load, if equipped with pneumatic tires; 65c if equipped with solid rubber tires, and 90c if equipped with metal tires. Maximum weight of vehicle and load allowed on the highways, 20,000 pounds.

### **Road Funds**

Funds available for construction of State aid and Federal aid roads in 1922 will amount to \$200,000. The estimated revenue for automobile licenses for 1922 will be about \$1,000,000, which will be used for maintenance and reconstruction. The towns will raise about \$200,000 for construction and about \$700,000 for maintenance to match the above mentioned State money. There will be available \$365,000 Federal money for Federal aid, which will be matched with a part of the above joint funds.

### **Progress Report**

During 1921 75 miles of road were improved, comprising 5 miles of grading, 62 miles of gravel and 8 miles of bituminous macadam. Fifty miles of road were resurfaced, consisting of gravel, bituminous macadam and bituminous concrete.

There are 15,373 miles of road in the State, of which 1,668 miles have been hard surfaced.

Of the trunk line and cross State roads authorized previous to 1922, comprising a total mileage of 1,400, 1,050 miles have already been constructed, leaving 350 miles to be built.

### **State Highway Officials**

State Highway Department, Concord.—F. E. Everett, State highway commissioner; Clara C. Howe, chief clerk; Hubert E. Sargent, designing and office engineer.

Approved by F. E. Everett, State highway commissioner.

Revised by H. E. Sargent, designing and office engineer.

## **NEW JERSEY**

### **State Highway Legislation**

A State aid law was first passed by the legislature in 1891, but did not become operative until 1892, when the first State aid appropriation of \$75,000 was made. Under the original law the administration of the department of public roads was vested in



the secretary of the State department of agriculture. In 1894 the State-aid act was amended to provide for the appointment of a commissioner of public roads to administer the affairs of the department. The legislature of 1899 provided for a State highway engineer to assist the commissioner. This method of administration was followed until 1917. The first State aid acts provided that one-third of the cost of construction be paid by the State. This was amended in 1912, allowing the State to pay 40 per cent and providing that plans and specifications be approved by the State commissioner of public roads. This procedure held until 1917. The State aid system comprises approximately 2,672 miles.

In 1917 the legislature passed what is known as the Edge highway act, providing for the establishment of a State highway system. This system embraces sixteen routes, including 725 miles, and is being improved with durable materials. The State has absolute control of construction and maintenance, and will pay the entire cost.

The 1917 law established a State highway department and provided for the appointment of a State highway commission of eight members, a State highway engineer, assistant State highway engineer, and a secretary. The governor of the State is ex-officio a member of the commission and is entitled to vote in case of a tie. Two members of the commission must be competent engineers.

In 1916 the legislature passed what is known as the township aid act, providing for the setting aside from motor vehicle funds the sum of \$110,000, to be available in the sum of \$5,000 to the townships of each county of the State. This act was amended in 1920 to provide for a fund of \$210,000, or \$10,000 for the townships of each county. In this class of work the State may pay 75 per cent of the cost.

The work of the State highway department is divided into four branches, namely: Administrative, construction, maintenance, and tests.

### **Local Legislation**

County roads are under the jurisdiction of a board of chosen freeholders of the county, which appoints a county road supervisor and a county engineer in charge of roads and bridges. There are about 2,400 miles of county roads in the 21 counties of the State. All other roads not included in the State or State aid system are constructed and maintained by township authorities.

### **Bond Legislation**

No State bonds have been issued for road improvement, but the legislature of 1920 passed an act providing for the issuance

of \$28,000,000 bonds for the construction of a vehicular tunnel under the Hudson River between New York and New Jersey, and a bridge over the Delaware River between Camden and Philadelphia. This bond issue was approved by a majority of the voters of the November election, 1920. The administration of this work comes under the jurisdiction of the Interstate Bridge and Tunnel Commission, which body is proceeding with the preliminaries in connection with the tunnel construction.

Counties and townships are authorized to issue bonds for road and bridge construction. The limit of the indebtedness is 4 per cent of the assessed valuation for counties and 7 per cent for townships. For township bonds a referendum vote is provided for in case taxpayers representing 10 per cent of the assessed value of the property in the townships sign a petition for them. County boards of chosen freeholders may issue bonds without a referendum vote. The terms of all bonds are limited to the probable life of the improvement for which the bonds are issued, as follows: For stone, concrete and iron bridges, 30 years; for road built of concrete 6 inches thick or of blocks of any material, or sheet asphalt laid on macadam concrete foundation, 20 years; for water-bound macadam surfaced with bitumen, 10 years; for bituminous concrete construction, 15 years, and for gravel, 5 years. The law also provides that all bonds be paid off by the deferred serial method, the first payment commencing not more than two years from the date of issue.

### **Convict Labor Laws**

The board of chosen freeholders of any county may authorize the sheriff to cause all able-bodied convicts, or as many as may be required, to be put to work on the public roads of the county.

The authorities of the State department of institutions and agencies may enter into an agreement with the State highway commission or other departments of the State government for the employment of prisoners on public work. The State prison labor commission is authorized to acquire land for agricultural and quarry purposes and to transfer prisoners to such lands.

### **Automobile Registration**

All motor vehicles are registered with the State commissioner of motor vehicles. The rate for passenger automobiles is 40c per h.p. up to 29 h.p., beyond which the rate is 50c per h.p.

The fee for commercial vehicles is based on the gross weight of the vehicle and carrying capacity and amounts to \$10 for the first 1,000 pounds, \$12 up to 2,000 pounds, \$15 to 3,000 pounds, \$20 to 4,000 pounds and \$24 to 5,000 pounds. Beyond this weight



the rate increases at the rate of \$3 for each additional 1,000 pounds up to 30,000, when the fee amounts to \$99.

### Road Funds

A State road tax of one mill on each dollar of assessed valuation provides an income of approximately \$3,500,000 per annum, which must be expended for the extension and construction of State highways. The income from the motor vehicle licenses, fines, fees, etc., is appropriated to the State highway commission to be apportioned for the repair and maintenance of roads. The net income from this source for the years 1921-1922 will be approximately \$5,300,000, of which amount \$2,000,000 is apportioned to the several counties of the State as an aid in the repair and maintenance of county roads. This year it was apportioned under a method where each county's percentage of population, road mileage and area was compared to the total population, road mileage and area of the State. These comparisons arranged in a per cent of the total value of the State at large and an average of these percentages would give the average per cent for each county, which average per cent multiplied by the total amount for distribution gives that county's apportionment.

The Federal aid act apportionment for the year 1921 was \$1,187,556 and for 1922 \$942,871. There is also appropriated by the legislature \$500,000 to be used in State aid or new construction, which is apportioned to the several counties of the State. An item of \$210,000 is taken from the motor vehicle receipts and set up to the credit of the township road improvements. This township aid money is used for the improvement of unimproved township roads. The total of all funds available to the State highway department for the fiscal year 1920-1921 was \$9,326,758.39. For fiscal year 1922, it is estimated that there will be available the following sums for construction: State road tax, \$3,500,000, of which \$2,400,000 is to be paid to counties in reimbursement for work done in 1921 on the State highway system, leaving an amount of \$1,100,000 available for 1922 highway construction; State aid appropriation, \$500,000; township aid appropriation, \$210,000; Federal aid, \$942,871; county funds, estimated, \$1,500,000.

In addition to the above stated funds, approximately \$8,000,000 is proposed to be spent for the State highway construction under the law which provides that the counties may construct portions of the State highway system after receiving permission of the State highway commission, by furnishing funds and being reimbursed from the funds to be collected under the one mill tax in some future year. The 1922 construction program is largely composed of this reimbursement work to the extent estimated

above, the counties to be reimbursed from the funds raised by the one mill tax in the years 1924, 1925 and 1926.

The 1922 road funds for maintenance and reconstruction will be made up as follows: Receipts from motor vehicle funds, \$5,300,000; county funds, estimated, \$4,000,000.

### Progress Report

Up to January 1, 1922, 142 miles of the total State highway system, comprising 726 miles, have been constructed and are now open to traffic. In addition to this, there are 70 miles under contract at the present time. The type of construction consists of 18 and 20 foot width of hard surfaced pavement suitable for traffic at all seasons of the year. The full graded width of 30 feet is maintained. In addition to this road mileage, a great number of bridges have been constructed to take the place of those inadequate to meet the traffic demand of today.

The 1922 program calls for the construction of approximately 130 miles of the same type of construction, different only in the respect that in the future all pavement width will be not less than 20 feet. This mileage of State highway construction will constitute the largest single year's program ever undertaken by New Jersey.

During the past year 25 miles of State aid routes were placed under construction or completed. All of this mileage is made up of hard surfaced pavements. There are also 23 miles of road reconstructed with money from the motor vehicle funds and 112 miles of township roads were placed under construction or completed during the year 1921.

There are in the State 17,121 miles of State, county and township roads. Up to July 1, 1921, there had been hard surfaced 6,384 miles as follows:

Gravel .....	2,485
Macadam .....	2,017
Bituminous Macadam .....	694
Bituminous on Macadam Base.....	602
Bituminous Concrete on Concrete Base.....	206
Brick .....	39
Stone Block .....	86
Portland Cement Concrete.....	255
Total .....	6,384

In addition to this, there were 593 miles of State, county and township roads under construction or completed during 1921, as follows:



Sheet Asphalt on Concrete Base.....	22
Sheet Asphalt on Stone Base.....	22
Bituminous Concrete on Concrete Base.....	53
Bituminous Concrete on Stone Base.....	18
Cement Concrete .....	138
Brick and Stone Block.....	6
Macadam Penetration .....	16
Macadam .....	68
Macadam Surface Treated.....	5
Gravel .....	245
Total .....	593

This makes in all 6,977 miles of improved road, which indicates that 40.7 per cent of the roads of the State are now hard surfaced.

### Maintenance

During 1921 the State highway department maintained 537 miles and expended for this purpose approximately \$1,800,000. During 1922 the State highway department will maintain approximately 400 miles at a cost of about \$1,500,000. The difference between this figure and the amount under maintenance in 1921 represents the approximate proposed mileage to be under construction during 1922.

### State Highway Officials

The State Highway Commission, Trenton: George L. Burton, chairman; John Ferris, George Paddock, Walter F. Whittemore, Thomas E. Collins, Albert S. L. Doughty, Charles F. Seabrook; A. Lee Grover, secretary.

Administrative staff: T. J. Wasser, State highway engineer; Edward E. Reed, assistant State highway engineer; C. F. Bedwell, construction engineer; A. Lee Grover, chief clerk.

Revised by T. J. Wasser, State highway engineer.

## NEW MEXICO

### State Highway Legislation

The State highway commission, a bi-partisan continuous body composed of three members appointed by the governor, is at the head of the highway department of the State. The State highway engineer, appointed by the commission, is the administrative and executive official in charge of all work under the direction of the commission. The compensation allowed each member of the highway commission is \$8 per day when actually engaged in official business. The State highway engineer's salary is not fixed by law, but by the commission, at \$5,000.

The commission is required to construct and maintain, at the expense of the State, either in whole or in part, such roads as will best serve the interest of the general public and looking to the construction of a complete system of highways. Funds are provided by a State tax of  $3\frac{1}{2}$  mills on each dollar of taxable property in the State. The State highway commission maintains over 3,000 miles of roads under the law with patrol system. A bond issue of \$2,000,000 was authorized at an election held September, 1921.

### **Local Road Legislation**

The 1921 session of the legislature passed an act which does away with the county road superintendents and places county road matters in the hands of the respective boards of county commissioners, who may employ road supervisors for such road districts as may be defined in the various counties by the commissioners. These road supervisors are to be paid \$4 per day for the time actually employed. The respective boards of county commissioners must prepare and adopt a plan of road work for the ensuing year covering all expenditures of road and bridge funds, after publication of the time and place of meeting for adoption of such road plans and expenditure.

Under this law, the commissioners may, if they so elect, turn all of their county road work and funds for same over to the State highway commission for handling.

### **Local Bond Legislation**

When petitioned by not less than 10 per cent of the qualified electors of the county who are taxpayers, the board of county commissioners may submit the question of issuing bonds of the county for road purposes. A majority of those voting is required to authorize the bonds. The amount of the bonds shall not exceed in the aggregate, including existing indebtedness, 4 per cent on the value of the taxable property within the county, shall bear not to exceed 5 per cent interest, and shall run not to exceed thirty years, but may be made redeemable prior to the date of their maturity, as may be provided by order of the commissioners. An additional annual tax levy shall be created to meet the interest charges on the bonds, and there shall be created a fund to be known as the "county highway sinking fund," which shall be used for the redemption of the bonds.

### **Convict Labor**

Under an agreement between the State highway commission and the board of penitentiary commissioners convicts are used quite extensively on State road work. The State highway com-



mission pays to the penitentiary \$1.50 per man per day when he is actually at work. The penitentiary is responsible for the transportation, guarding, feeding, clothing, medical attention and discipline of the convicts, and furnishes all labor on the road grade. The highway department supervises the work of the convicts.

### Automobile Registration

The law provides for the registration and licensing with the Secretary of State under the following schedule of fees: Automobiles, 40 cents per h.p.; motor trucks with two or more solid tires, 50 cents per h.p. The net revenue from licenses goes to the State road fund for expenditure under the direction of the State highway commission.

### Road Funds

During the year 1922 approximately the following funds will be available for expenditure:

State Bonds .....	\$2,000,000
State Funds .....	1,600,000
County Funds .....	500,000
County Bond Issue .....	200,000
Federal Fund .....	1,600,000

The State road fund is derived from the net automobile license fees, amounting to about \$200,000 a year; receipts from a 3½ mill State wide tax, about \$1,400,000 a year, and an excise tax of 1 cent per gallon on gasoline, about \$80,000 a year.

### Progress Report

During 1921 a total of approximately 900 miles of road were improved, including construction of necessary drainage structures, such as syphons, culverts, spillways and bridges, with total expenditures amounting to \$3,238,366.22, which includes an estimate of \$500,000 for county work, the balance being actual expenditures on State road work. The Logan Bridge across the Canadian River has just been completed, which has a total length of 734 feet, including in this length one steel arch span of 420 feet.

### State Highway Officials

State Highway Commission: President, Charles Springer, Cimarron; secretary, H. L. Hall, Chama; member, D. W. Jones, Clovis; State highway engineer, L. A. Gillett, Santa Fe; assistant State highway engineers, Charles A. May and N. W. McCluskey, Santa Fe.

Revised by Charles A. May, assistant State highway engineer.

## NEW YORK

### State Highway Legislation

The State commission of highways consists of a single commissioner, who is appointed by the governor, with the consent of the senate, for a period of five years. The commissioner of highways appoints a secretary, an auditor and three deputy commissioners. Each of the deputy commissioners has had practical experience in the actual building, construction and maintenance of highways and is familiar with the operations and effect of State statutes relating to highways and bridges.

The first deputy is a practical civil engineer, whose duties relate to the plans, specifications and performance of all contracts awarded by the department. The second deputy's duties relate to the maintenance of State and county highways, and the third deputy's duties relate to the improvement and maintenance of town highways and bridges.

The commissioner has general supervision of highways and bridges, constructed or maintained in whole or in part by the aid of State money; aids district, county and town superintendents by advice and information; investigates methods of road construction and maintenance; compiles statistics, including a highway map of the State; holds public meetings, etc.

The State is divided by the commission into not more than nine divisions, each in charge of a division engineer, who, under the direction of the commission, makes surveys, plans, specifications and estimates for the construction and maintenance of highways in his division constructed wholly or in part by the aid of State money.

All State and county highways on which the State expends money are inspected annually and a report prepared showing their condition, the improvements necessary, and the estimated cost, and a report is made annually to the legislature setting forth the amount required for maintenance for the ensuing year.

The highways of the State are divided into six classes, viz., State highways constructed or improved solely at the expense of the State; State highways constructed with State and Federal money; county highways improved at the joint expense of the State and county; county highways constructed jointly with State, Federal and county money; town highways improved by the towns with State aid, and county roads constructed by the county without State aid. The State and county improved highways are maintained almost entirely at the expense of the State, each town paying annually toward such maintenance the nominal sum of \$50 per mile for each mile or fractional part thereof, of the improved State and county highways within the town boundary.



The maintenance of town highways is included in the term "construction." The expense of maintaining county roads is a county charge.

The system of State highways as designated by chapter 18 of the laws of 1921 embraces 50 routes and includes 4,715 miles, most of which have been improved with hard surfaces. The system of county highways as designated by chapter 18 of the laws of 1921 includes 6,545 miles, about 5,500 miles of which have been surfaced. The cost of improvement of State highways is provided by funds obtained from the sale of State bonds or by direct legislative appropriation. The State's share of the cost of improvement of county highways is secured from the same sources. The balance of the cost of county highways is borne by the county.

The board of supervisors of a county may petition for the improvement of any county highway designated by chapter 18 of the laws of 1921. If the State commission of highways approves the request the division engineer prepares plans and specifications, which are then sent to the county superintendent, and upon his approval thereof they are forwarded to the commission for approval, after which they are submitted to the board of supervisors for final approval and appropriations of the county share of the cost. The commission may then advertise for proposals, award contracts, and carry on the work of improvement. The plans for State highways are prepared by the division engineer, approved by the county superintendent, and finally adopted by the commission, and the work carried on in the same manner as that of county highways.

After the final payment under any contract the State commission files a statement of cost with the county treasurer, who thereupon pays upon the request of the commission the county's share, as follows: 2 per cent of the cost to each \$1,000 of assessed valuation of real and personal property in the county for each mile of public highway in such county, not to exceed 35 per cent of the cost for the county. The maintenance of State and county highways is under the direct supervision of the commission, which also has authority to provide for a system of patrol of highways, the patrolman to be appointed by the State commissioner of highways.

The State contributes to town highways on the following basis: (1) Where the assessed valuation of the town is less than \$5,000 for each mile of highway in the town, outside of incorporated villages, an amount equal to the amount of taxes raised for highways; (2) where the assessed valuation is \$5,000 or over and less than \$7,000 per mile, an amount equal to 90 per cent of such taxes; (3) where the assessed valuation is \$7,000 or over and less than \$9,000 per mile, an amount equal to 80 per cent of such

taxes; (4) \$9,000 or over and less than \$11,000, 70 per cent; (5) \$11,000 or over and less than \$13,000, 60 per cent; (6) \$13,000 or over, 50 per cent. No town shall receive in one year an average of more than \$25 per mile for the total mileage of roads outside of incorporated villages, and the amount which is raised by local taxation shall be such as will, when added to the amount received from the State, be not less than \$30 for each mile of highway in the town.

A State bond issue of \$50,000,000 was authorized in 1906 and an additional issue of \$50,000,000 in 1912. The bond issue was originally intended for the improvement of a system of county highways aggregating 8,380 miles, and to this was added a system of State highways aggregating 3,617 miles of the later bond issue; \$20,000,000 is being expended for the construction and improvement of State highways and \$30,000,000 for the construction and improvement of county highways. The apportionment among the counties is on the basis of population, the measured mileage of public highways outside of cities and villages, and the total area, each factor having a weight of one-third. Direct appropriations are made by the legislature for maintenance.

*Civil Service.*—The State commissioner of highways appoints such resident engineers, district superintendents, clerks, officers and employees as may be required, subject to the civil service law and other provisions of law, within the amount appropriated therefor, unless the appointment of such clerks, officers, or employees is otherwise provided for by law.

District superintendents are appointed from lists prepared from examinations which test their qualifications for the actual construction and maintenance of highways and their executive capacity, rather than their scientific attainments. Clerks, other than those employed in the principal office of the commissioner of highways, inspectors, and other employees in the department, whose duties pertain to the maintenance of highways, are likewise selected from lists prepared from examinations, testing their general knowledge of the highway law and of the practical construction of highways.

Inspectors of construction, other than engineers and levelers, are selected from lists similarly prepared, except that they must be residents of the county in which the highway constructed or improved is located. To the end that the employees of the department of highways engaged in the work of constructing, improving or maintaining highways under the provisions of this chapter may be practical highway builders, the commissioner of highways is authorized to indicate to the civil service commission the relative value which should be given to experience and scientific attainments. The commissioner of highways has the power, subject



to the provisions of the civil service law, to remove engineers, officers and employees of the department.

*Federal Aid.*—There has been apportioned to the State, by the Secretary of Agriculture, the sum of \$17,385,249.64 from the appropriations of \$75,000,000 and \$200,000,000 and \$75,000,000 made by Congress.

### **Local Legislation**

New York has a rather centralized system in that the State highway commission, by reason of its extending aid to counties and townships, exercises a limited supervision over practically the entire road mileage of the State. In the counties the governing body is the board of supervisors and in the townships the township board. The county superintendent of roads is appointed by the county board of supervisors, but if they fail to make such an appointment the State highway commission makes it or includes the county in a district and appoints a district superintendent. The term of office of the superintendent is four years, but he may be removed by the State highway commission upon written charges. He is subject to the rules and regulations of the commission. The town elects biennially a town superintendent of highways who has supervision of the highways therein, subject to the regulations of the State commission. The State grants aid in the construction and maintenance of practically every type of road in the State and the various road officials conduct their work in accordance with the regulations prescribed by the State highway commission.

### **Local Bond Legislation**

The county board of supervisors may, by resolution, authorize the issuance and sale of bonds for paying the county's share of the cost of any highway. These bonds must not be sold for less than par, and the amount of the issue must not increase the total county indebtedness to more than 10 per cent of the assessed valuation.

For the purpose of purchasing toll roads and bridges, the county board may issue bonds which shall bear interest not exceeding 5 per cent, shall run not longer than 20 years, and shall not be sold below par.

Towns may issue bonds for road purposes when authorized by the county board of supervisors. By a majority vote a town may increase the amount of issue to one-third of its assessed valuation.

### **Prison Labor**

The superintendent of State prisons may employ the convicts confined in the State prisons in the construction or maintenance

of the public highways at any place within the State, outside of any incorporated village or city upon request or with the consent of the commissioner of highways.

### Automobile Registration

All motor vehicles are registered annually with the State Tax Commission. The fees for passenger cars are arranged on a horsepower rating plus a fee on the price and age of the car according to tables furnished on application blank; 40 cents per horsepower plus 40 cents for each \$100 of list price if manufactured within three years from the time the car is registered. If manufactured within three to five years, 20 cents per \$100 and 10 cents for each \$100 for subsequent registration. For trucks and delivery cars 2 tons or less, \$10; more than 2 tons and not over 3 tons, \$15, with a graduated scale of \$5 for each additional ton to 14 tons. Over 14 tons the rate is \$70, and \$10 for each ton in excess of 14 tons.

The State Tax Commission receives all fees from registrations, fines and forfeitures in the first instance. Seventy-five per cent of the receipts is turned over to the State treasurer and after appropriation by the legislature is used by the State commission of highways for the repair and maintenance of State and county improved highways. The remaining 25 per cent is distributed among the counties in which the fees were collected, each county thus receiving 25 per cent of the total amount of fees paid by residents of that county. The money received by a county is used for the permanent construction or improvement of town highways in the county or for the repair of highways heretofore improved by the aid of the county. The city of New York receives 25 per cent of the total amount of fees collected in that city, in the same manner as the counties receive their proportionate share.

### Road Funds

All of the funds available from the two State bond issues of \$50,000,000 each have been appropriated by the legislature and expended or obligated and funds for highway work in the State during 1921 were derived as follows:

State appropriations .....	\$13,645,627.70
Federal appropriations .....	6,493,130.20
County appropriations .....	6,142,292.51
City, village and town appropriations.....	1,345,700.00

The above amount was expended in the construction, reconstruction and maintenance of the highway systems.



### Progress Report

During the year 1921, 167 construction contracts were awarded for a total of 615 miles with and without Federal aid, and there was actually constructed by the department 632 miles of pavement.

There were awarded during the year 46 contracts without Federal aid for reconstruction or resurfacing covering 98 miles at a cost of \$2,019,948, 20 contracts for reconstruction and resurfacing with Federal aid total 69 miles at a total cost of \$1,651,000 and 53 miles of reconstruction and resurfacing done by department forces. Ninety-six miles of highways were surfaced and treated with bituminous material under contract at a cost of approximately \$52,000 and 1,826 miles of highways were surfaced and treated with bituminous material and covered, the work being performed by department forces, making a total expenditure for the maintenance of improved highways during the year \$9,965,494.

### State Highway Officials

State commissioner of highways, Herbert S. Sisson; first deputy commissioner, Fred W. Sarr; second deputy commissioner, H. G. Hotchkiss, Jr.; third deputy commissioner, William B. Reed; secretary, Jeremiah C. Finch; auditor, Charles V. Platt; assistant secretary, Frank R. Pennock.

Revised by J. C. Finch, secretary, Albany, N. Y.

## NORTH CAROLINA

### State Highway Legislation

The State highway commission is composed of ten members, including the chairman, all of whom are appointed by the governor, subject to confirmation by the senate. The chairman, who is a practical business man, is termed the State highway commissioner and devotes his entire time to the work of the commission, receiving therefor a remuneration of \$5,500 per year in addition to his actual travelling expenses. Nine commissioners, three of whom are from the minority political party, are appointed from the nine construction districts for terms ranging from two to six years, after which the term will be for six years, thus establishing a continuous commission. These commissioners receive \$10 and their actual travelling expenses for each day that they are engaged in the discharge of their duties.

A State highway engineer is employed by the commission who is a competent civil engineer qualified by technical training as well as by practical experience in highway construction and maintenance. This engineer may serve for a term of four years without reappointment and receives a salary fixed by the commission

with the approval of the governor. He is in direct charge of all construction and maintenance work on the State highway system, and other engineering work carried on by the commission.

The State is divided into nine construction districts, each of which is in charge of a district engineer, who reports directly to the State highway engineer. This district engineer has general supervision of all work, both maintenance and construction, in his particular district, and is assisted by a district construction engineer and a district maintenance engineer, together with such other help as may be required to make surveys, carry on construction and maintenance, etc. All plans, both for road and bridge construction, are drafted in the main offices of the commission, and all public lettings are held at headquarters.

The State highway commission has charge of the construction and maintenance of all roads making up the State highway system. Approximately 6,000 miles of highways connecting county seats and the principal towns of the State comprise this system upon which State and Federal funds are expended. The cost of construction of the State highway system is borne entirely by the State except in cases where the Federal government participates, construction funds being derived from a bond issue of \$50,000,000 authorized by the general assembly of 1921. Maintenance funds are secured from the revenue accruing from the registration of motor vehicles, plus a tax of one cent per gallon on gasoline.

### Local Legislation

Each county is governed by a board of county commissioners of from three to seven members elected usually for a period of two years. Thirty-seven counties have five commissioners, one county has six commissioners, one has seven, and one county elects its commissioners for four-year terms. The county board has charge of the layout, altering, construction, and maintenance of all local roads and bridges not included in the State highway system, and the raising of money therefor.

In carrying out road work in the different counties there is considerable variation in organization and procedure. Many counties in which bonds have been issued have boards of county road commissioners who are given power to employ engineers, or superintendents, and to make contracts, and to buy machinery. In some counties the work is done under the direction of county engineers, in others by county superintendents while in others the work is done by township supervisors. The township supervisors are elected for two-year terms and have charge of the maintenance of roads and bridges in their respective townships.

There are 25 counties that have county engineers. Such engineers are usually employed by those counties in which ex-



tensive improvements are under way, and when the work is being done by contract. In such cases the engineer makes all surveys, prepares plans, specifications and estimates, acts as inspector and prepares and approves monthly estimates which are submitted to the county board for payment. County engineers are usually appointed by the county commissioners on the recommendation of the State highway engineer. The county superintendents are usually practical road builders employed in counties where the work is done by force account or with convict gangs. As a rule they are not civil engineers and are, therefore, incapable of making surveys, preparing plans, specifications and estimates.

### **Bond Legislation**

The general assembly of 1921 authorized a bond issue of \$50,000,000 to carry out the provisions of the State road law, also passed at this session, and to enable the State to avail itself of Federal-aid funds for road construction purposes. These bonds, known as "State of North Carolina Highway Serial Bonds," are payable in not less than ten nor more than forty years from date of issue and bear a rate of interest determined by the governor and council of State, but not to exceed 5 per cent. Not more than \$10,000,000 of the bonds are to be issued and sold in any one year unless the progress of highway work is such as to justify it, in which event an additional sale may be made at the request of the State highway commission and with the consent of the governor and council of State.

Counties and townships may issue bonds for road and bridge improvement in amounts not to exceed 10 per cent of the taxable valuation of the property. Before such bonds are issued the question must be submitted to the qualified voters of the county or township and a favorable vote returned by a majority of the voters, but before such election can be held, the State highway engineer must certify that the proposed issue will be sufficient for the purposes set forth in the petition for the election. The term, character and interest rate of the bonds are left to the discretion of the authorities issuing them. In case the bonds are issued, special taxes must be levied in sufficient amounts to pay interest and principal and to maintain the roads constructed. The tax for maintenance shall not be less than 1 per cent nor more than 4 per cent of the bonds issued. A large mileage of the improved roads of North Carolina has thus been financed from bond issues.

### **Convict Labor**

All able-bodied male convicts sentenced to the State prison may be assigned to work upon the State highway system under the direction of the State highway commission, at a price agreed upon

between the State highway commission, the governor, and the chairman of the State prison board, on the basis of paying the actual expenses in working said convicts, including food, clothing, housing, guarding, transportation, and incidental expenses by the State highway commission to the prison board.

The State highway commission may make contracts and agreements with the board of county commissioners or road governing bodies of any county in the State for the purpose of hiring any county convicts to be worked on the State highway system or in the production of materials therefor.

### Automobile Registration

Automobiles are registered annually with the Secretary of State, the fees being as follows: 24 h. p. or less, \$12.50; 24 to 30 h. p., \$20; 30 to 35 h. p., \$30; 35 h. p. or more, \$40. Motor vehicles used for the transportation of passengers for hire pay 50 per cent more than the above rates.

Trucks with carrying capacity less than 1,000 pounds, \$12.50; 1,000 pounds and under 1 ton, \$15; 1 to 2 tons, \$25; 2 to 3 tons, \$75; 3 to 4 tons, \$200; 4 tons and over, \$300. On all trailers, \$15 per ton carrying capacity.

Motorcycles, \$5; motorcycle sidecars, \$5; dealers, \$25 for five plates and \$1 for each additional plate.

### Road Funds

Funds for road construction are derived from the bond issue of \$50,000,000 previously mentioned, together with such funds as may be received from the Federal government. Revenue derived from the automobile registration fee and the tax levied on gasoline—one cent per gallon—is used in maintaining the roads on the State highway system and for the operating expenses of the State highway commission. In 1921 this revenue amounted to approximately \$2,500,000.

### Progress Report

During 1921, 381 miles of top-soil, sand-clay, or gravel roads were completed at a cost of \$3,952,666, while of the hard-surfaced type of construction the following work was completed: Cement concrete, 16.6 miles, at a cost of \$629,324; Topeka, Warrenite, or other bituminous concrete types, 48.92 miles, at a cost of \$1,877,675; penetration macadam, 14.65 miles, at a cost of \$449,299; waterbound macadam, 5 miles, at a cost of \$153,899; and bridge-work to the amount of \$250,413 was completed; making a total of work completed during 1921 of 466.42 miles of road valued at \$7,313,276.



On January 1, 1922, work under contract or construction amounted to 890.88 miles of road estimated to cost \$14,192,924, the types being divided as follows: Top-soil, sand-clay, or gravel, 590.46 miles, costing \$5,061,470; 27.42 miles of reinforced concrete, costing \$915,436; 36.36 miles of plain concrete pavement, estimated to cost \$1,417,435; Topeka, Warrenite, or other similar types, 147.79 miles, costing \$4,705,581; 27.31 miles of penetration macadam, costing \$536,358; waterbound macadam, 61.54 miles, estimated to cost \$1,169,790; and bridge-work which will cost \$386,855.

### State Highway Officials

Frank Page, State highway commissioner and chairman; commissioners: J. E. Cameron, First District; W. A. Hart, Second District; W. A. McGirt, Third District; John Sprunt Hill, Fourth District; J. Elwood Cox, Fifth District; W. C. Wilkinson, Sixth District; R. A. Doughton, Seventh District; J. C. McBee, Eighth District; J. G. Stikeleather, Ninth District; State highway engineer, Charles M. Upham.

Revised by H. K. Witherspoon, engineer in charge, publications and statistics, Raleigh, N. C.

## NORTH DAKOTA

### State Highway Legislation

At the general election on November 3, 1914, an amendment to the constitution was adopted, providing that the State may grant aid in the construction and improvement of public highways.

In 1917, the legislature passed a law creating a State Highway Commission, assenting to the Federal Aid Road Act, etc. The commission is composed of the governor, the commissioner of labor and agriculture, the State engineer, whose duty as such is still entirely independent of the State highway department and who is ex-officio chief engineer and secretary of the commission, and two civilian commissioners appointed by the governor at \$10 per day and expenses, salary limited to \$600 per annum.

The commission is authorized to lay out a State highway system in conjunction with the several county boards, the system to consist of the main traveled roads in the counties. Changes in the system may be made by the chief engineer with the approval of the commission. At present, the system comprises about 5,600 miles, or about 8 per cent of the entire mileage of public highways in the State.

The total mileage of public highways is not less than 70,000 (1915 figures). A new determination is being made (Dec., 1921), which will probably exceed 70,000.

The commission prepares plans and specifications for all State and Federal-aid projects, grants aid therefor, awards contracts with the approval of the county boards, directs and supervises the construction work, etc.

In 1919, the existing law was amended in certain respects, the most notable of which are that the commission "shall determine the character and have general control and supervision of the construction and reconstruction of all bridges, culverts, and other highway structures, and of all other improvements on the system of highways"; that the State directs and supervises the maintenance of the entire system of State highways; that it may purchase right-of-way for gravel pits, etc.; that there is placed at the disposal of the commission the laboratories, etc., of the State educational institutions and that the collection, etc., of the automobile registration fees is taken over by the State highway department.

State aid is granted on a 50-50 basis as far as possible. County and State-aid funds are used jointly to secure Federal aid. There are no funds, except those for the operation of the State highway department, independently available for expenditures by the commission. County funds are always involved.

### Local Legislation

In counties having no civil township organization the county board of commissioners acts as a highway board; in organized townships the authority is vested in the board of supervisors. In localities where there is unorganized territory the county commissioners may create as many road districts as in their judgment is deemed expedient and may appoint for each district an overseer of highways. At the first meeting of a township board, succeeding the annual town meeting, township overseer is appointed to have direct charge of the construction and maintenance of highways. In unorganized territory the district overseer of highways have the same powers and duties as township overseers of highways in organized townships. In counties having a county superintendent of highways the township road overseer is ex-officio deputy county superintendent of highways for his respective township. A law was passed in 1915 creating a board of highway improvements in each county, consisting of one member from each road district, which is required to formulate plans and methods for the uniform working and establishing of highways within the county. Such methods as they adopt must be followed in each of the districts in the county, but there is no penalty for failure to do so.



### **Bond Legislation**

A State highway bond issue bill for \$4,000,000 was introduced in the legislature in 1919 but was withdrawn upon the discovery of its unconstitutionality. Later a concurrent resolution to submit to the people in referendum an amendment to the constitution, making a \$50,000,000 bond issue for road purposes possible, was also defeated.

Section 183 of Article 12 of the constitution authorizes counties, townships, cities, towns, or other political subdivisions to create an indebtedness not to exceed 5 per cent of the assessed valuation of the taxable property, but apparently there has been no general statutory enactment permitting the creation of an indebtedness for road purposes under authority thus conferred.

### **Convict Labor Laws**

The State law provides that inmates of the State penitentiary may be used upon the public highways. No convict labor has ever been used, for the reason that all of the convicts are needed to keep the regular industries of the penitentiary in operation.

### **Automobile Registration**

The State highway department has control of the registration of motor vehicles. The 1919 law provides that the fee shall be paid on the basis of horsepower, weight, and factory selling price, as follows: 5 mills per dollar of selling price, plus 20 cents per 100 lbs., or major fraction thereof for the net weight of the vehicle, and 10 cents per h. p. A reduction of 10 per cent of these rates is allowed for the second year, a 25 per cent reduction for the third year, and thereafter a 40 per cent reduction, provided that the fee shall at no time be less than \$5 per car. Trucks same as for passenger cars, plus \$3, \$5 and \$10 per ton for trucks having capacity of less than 3 tons, 3 to 4 tons, and over 4 tons, respectively.

### **Road Funds**

Funds expended by the State highway commission are derived from the automobile fees, of which not more than \$150,000 annually may be used by the commission for administration, engineering and general operation, including the cost of collection of the fees. The operating fund is insufficient to provide the engineering for all the State-aid and Federal-aid work undertaken, and consequently it has become necessary to charge the engineering to the "State Aid Fund" mentioned below.

By legislative acts, drafts have been made on the motor-vehicle license fees in order to pay the State's one-third of the cost of construction of the State highway bridges over navigable streams.

One-half of the remainder is returned to the county treasurers and is known as the "Special Road Maintenance Fund," to be expended under the direction of the commission, primarily for the maintenance of the State highway system. However, due to lack of funds for proper administration of general State highway maintenance, only about one-third of the State highway mileage is maintained under State direction, the "special road maintenance funds" of many counties being expended by the county commissioners without State supervision.

Motor trucks, etc., secured from the War Department have been utilized for State highway maintenance. These trucks are used for gravel surfacing on Federal-aid work when they are not required for maintenance.

The remaining one-half is known as the "State Aid Fund," 90 per cent of which is credited to the counties and remains in the State treasury until expended, upon action by the State highway commission, on construction (and engineering—see foregoing) in the several counties, in the same proportion as that in which the fees are collected in the counties, except that if any county has unused State aid to its credit in excess of \$3,000 or an amount greater than its accumulated credit for three years, the commission may direct the county to utilize it (on a State-aid or Federal-aid project), and on its failure to do so the commission may expend it at its discretion.

The remaining 10 per cent is expended at the discretion of the commission. Due to the failure of the legislature to provide the necessary funds, this fund was used to pay loading and freight charges for, unloading, putting into operating conditions, the excess War Department materials.

County road and bridge levies in 1921 were about \$3,500,000, of which about \$1,200,000 was utilized to meet Federal aid. The township road and bridge levies for 1921 are about \$2,200,000 and city, town and village levies are about \$100,000, making a total of \$5,800,000 for the entire State, exclusive of any State aid or Federal aid. State aid available will amount to about \$200,000 annually.

About the same levies (county, townships, cities, towns and villages) are expected for 1922; likewise a similar amount of State aid.

Funds expended or to be expended by the State during 1921 and 1922 are as follows:

Source	1921	1922
Federal aid .....	\$1,200,000	\$1,300,000
State aid .....	400,000*	300,000*
County funds .....	1,200,000	1,300,000
Total .....	\$2,800,000	\$2,900,000

\*One-half for maintenance of State highways.



### Progress Report

Since the creation of the State highway commission, in 1917, about 1,200 miles of State highway projects have been completed or placed under construction. The work is almost entirely Federal aid and about 88 per cent is grading and draining or earth road construction and about 12 per cent is gravel surfaced. Two miles of concrete pavement at Grand Forks were completed in 1921.

The \$1,390,000 highway bridge, financed one-half by Federal aid, one-third by the State and one-twelfth by each of the two counties, over the Missouri River between Bismarck and Mandan and begun in 1920, will be completed early in 1922. The structure lies on the National Parks (transcontinental) Highway and is the only highway bridge across the Missouri River in North Dakota.

Work contracted for in 1921 and expected to be placed under construction in 1922 is as follows:

<i>Type</i>	1921		1922	
	<i>Miles</i>	<i>Cost</i>	<i>Miles</i>	<i>Cost</i>
Concrete.....	2	\$ 134,000	0	0
Gravelling.....	54	275,000	200	\$ 600,000
Earth.....	375	2,191,000	500	2,150,000
Total		\$2,600,000		\$2,750,000

### Maintenance

Under direct supervision of the State highway commission there was maintained 750 miles of road during 1921 at a cost of \$37,000. It proposes to maintain 3,000 miles during 1922 at a cost of \$225,000.

State highways are maintained from the special road maintenance funds (see previous paragraph under "Road Funds").

### State Highway Officials

State highway commission: Hon. R. A. Nestos, governor, chairman; Hon. Jos. A. Kitchen, commissioner of labor and agriculture; W. H. Robinson, State engineer, chief engineer and secretary; H. Hardt, commissioner; Benton Baker, commissioner.

Department organization: W. H. Robinson, chief engineer; J. E. Kaulfuss, assistant chief engineer; L. O. Marden, bridge engineer; H. O. Wray, road engineer; H. K. Craig, maintenance

engineer; Geo. E. Hanson, chief draftsman; B. R. Dow, chief clerk; E. P. Crain, registration clerk.

Prepared by J. E. Kaulfuss, assistant chief engineer, Bismarck.

## OHIO

### State Highway Legislation

The division of State highways comprises one of three divisions of the department of highways and public works. At the head of the department is the director of highways and public works, and at the head of the division of highways is the State highway engineer. The salary of the director is \$6,500 and of the State highway engineer \$5,000.

The State highway department has general supervision over the construction and maintenance of State roads, inter-county highways, and main market roads, and must approve plans, specifications and estimates for all other road, culvert and bridge work on request.

The engineering work of the department is conducted under the direction of three chief engineers of bureaus—one in charge of the bureau of construction, one in charge of the bureau of maintenance, and one in charge of the bureau of bridges. Each chief engineer receives \$4,500 per annum. There is also in each bureau an assistant chief engineer.

The chief engineer of construction is in charge of field work for all the bureaus and has direct charge of the eleven division engineers, appointed by the direction and not under civil service. There are also eleven assistant division engineers who are under civil service. Resident engineers are provided for each county and the director may or may not appoint the county surveyor at his discretion. The State pays one-fifth of the salary of the county surveyor where the county surveyor is appointed as resident engineer of the department.

There are 510 inter-county highways in the State embracing 10,068 miles, forming a continuous State system. These roads were selected by the highway department and were legally adopted by the governor's approval in December, 1912. From this system the legislature in 1913 designated 12 main market roads. This number has since been increased by the State highway commissioner, with the approval of the governor, to 31, and includes about 3,000 miles of the inter-county highway system.

Applications for State aid on inter-county highways or main market roads originate with the county commissioners or township trustees. Contracts are let by the State. If counties or townships do not make application for aid, the State highway department may proceed with the work without local initiative.



and pay the whole cost of construction except 10 per cent, which is assessed against the abutting property owners.

When the State is coöperating with a county, the percentage of cost paid by the State, county, township and property owners are as follows: State, not to exceed 50 per cent; county, 25 per cent; township, 15 per cent; and property owners, 10 per cent. The State may pay less than 50 per cent, the balance being made up by the county. When the tax duplicate (assessed valuation) of a county is less than \$30,000,000 but not under \$22,000,000, the State may pay not over 75 per cent. When it is less than \$22,000,000, the State may pay 90 per cent. The county may assume the township's share or the township may assume the county's share.

Under all conditions the property owners are required to pay not less than 10 per cent of the total cost, but they may be assessed in an amount above this at the will of the county commissioners. The assessment may be made on a front-footage basis by unanimous vote of the county commissioners on property within one-half mile of the road. No part of the cost of bridges and culverts is assessed against the township or property owners, the cost being paid by the State and county in the same ratio as for road construction. State roads may be maintained by the State at State expense under the immediate direction of the county surveyor, but a portion of the cost of maintenance may be paid by the counties or townships.

### Local Legislation

County roads include all roads not State roads but which have been or may be surfaced under the direction of the county surveyor with hard materials to a standard fixed by the county commissioners. All other roads are under the jurisdiction of township trustees, who act under the general supervision of the county surveyor.

County commissioners may levy not to exceed 2 mills on the dollar on all property, including that in cities and villages, for maintenance of county roads and bridges, or a sufficient amount to produce at least \$100 for each mile of county roads. An additional levy of  $1\frac{1}{2}$  mills may be made to pay the county's portion of State roads. County roads may be improved under the local assessment plan on petition of 51 per cent of the abutting land owners, and the whole or a portion of the cost may be assessed against landowners within 2 miles of the road in proportion to benefits, or a portion of the cost not to exceed 50 per cent may be paid by the county or township. A special levy may be made by the county commissioners against the township for this purpose not exceeding 3 mills. Township road funds are

derived from a tax of 3 mills levied by the township trustees. Two additional mills may be levied to meet the township's portion of the cost of State roads. Township roads may also be improved under the local assessment plan on petition of owners, in which case from 25 to 50 per cent of the cost may be levied against abutting property within  $1\frac{1}{2}$  miles on either side or termini of the road.

### **Bond Legislation**

In anticipation of the collection of taxes or assessments to meet the county's or township's share of State roads or county roads built under local assessment plan, the county commissioner may issue sinking-fund bonds maturing in not to exceed 10 years and bearing not to exceed 5 per cent interest. The aggregate amount of such bonds for State roads must not exceed 1 per cent of the assessed valuation.

For the construction of township roads, the township trustees may issue bonds maturing in not more than 10 years and bearing not to exceed 6 per cent interest, upon the approval of a majority of the electors. The amount to be issued is left to the judgment of the township trustees.

### **Convict Labor**

State convicts may be used by the highway department through requisition on the State prison authorities in improving inter-county or main market roads, or in preparing materials therefor. The cost of transportation, guarding, clothing, and other expenses incident to such work may be paid by the State highway department from funds available for the construction of State roads.

### **Automobile Registration**

Automobiles are registered annually with the Secretary of State or through automobile clubs. The rate on passenger cars of 25 horsepower or less is \$8; 25 to 35 horsepower, \$12; over 35 horsepower, \$20; electrics, \$8. For trucks the same fees are charged as for passenger cars, plus 20 cents for each 100 pounds of gross weight of vehicle and load. Fifty per cent of funds collected are retained by the counties, and 50 per cent goes to the State for maintenance and repair of highways.

### **Road Funds**

The inter-county highway and main market funds are appropriated from funds derived from taxation by a levy of  $\frac{5}{10}$  of 1 mill upon all the taxable property of the State. The maintenance and repair fund is appropriated from the net funds derived from automobile license fees.



The inter-county highway fund is used for the construction, improvement, maintenance and repair of the inter-county highways and must be expended so as to produce an equal division among the 88 counties of the State of the moneys so appropriated by the general assembly for each 2-year period.

The main market fund is used on the main market roads of the State and is so expended as to distribute equitably, as far as practicable, the benefits to the different sections and counties of the State.

The maintenance and repair fund is used for the maintenance and repair of both the inter-county highways and main market roads. A part of this fund may be used to establish a system of patrol or gang maintenance on these roads.

### Progress Report

From January 1 to December 31, 1921:

Total expended on roads, bridges and culverts.....	\$12,412,716.67
Of this amount the State paid.....	\$5,000,000.00
And the counties paid.....	7,412,716.67
Number of miles under contract unconstructed on January 1, 1921 .....	743.58
Miles contracted .....	373.4
Total number of miles under contraction in 1921.....	1,116.98
Number of miles completed and opened to traffic.....	1,010.5

### Maintenance

During 1921 approximately 3,300 miles of road was maintained; during 1922, 4,300. The source of funds for maintenance is from the sale of automobile license tags, the State receiving 50 per cent, or during 1921 about three and a half million dollars, which will likely be a very fair estimate for 1922.

### State Highway Officials

Director, Leon C. Herrick; State highway engineer, E. C. Blosser; chief engineer, bureau of construction, G. F. Clements; chief engineer, bureau of maintenance, Robert N. Waid; chief engineer, bureau of bridges, Adolph Stellhorn.

## OKLAHOMA

### State Highway Legislation

The State department of highways is under the charge of the State commissioner of highways, who is appointed by the governor for an unlimited term. He is required to furnish, without charge, to any road official standard plans and specifications for roads and bridges, to report on plans and specifications submitted

by any road official, to compile statistics of the roads in the State, to establish in each county standards for the construction and maintenance of its roads and bridges and to advise with State and municipal authorities on water and sewerage projects. With the consent of the governor, he appoints a State engineer, an assistant State engineer and other assistants.

The board of county commissioners select not less than 10 nor more than 15 per cent of the total mileage of roads connecting principal market points in the county and joining similar roads in adjacent counties to serve as State roads, and such portions of the designated roads as are approved by the State commissioner of highways are adopted as State roads. If any county fails to designate such a road system the commissioner of highways has power to make the designation. These roads are improved at the joint expense of the State and counties under the direction of the State commissioner. The surveys and plans are prepared by the county engineers. All bridges and culverts must be permanent and approved by the department of highways.

*Federal Aid.*—In 1917 the legislature authorized the State highway department to conduct all negotiations with the U. S. Department of Agriculture as to Federal-aid projects and to spend all funds provided by the State or its subdivisions to offset such Federal-aid funds.

### Local Legislation

The board of county commissioners of each county must appoint a county engineer, who must pass an examination held for the State department of highways by a board composed of three disinterested civil engineers. One person may serve as county engineer for two or more counties.

All roads except State roads are under the township officials. When the State roads of a county are finished township roads of an equal standard of construction may be added to the State system. The road work of each township is under a road superintendent, but the plans and specifications must be furnished by the county engineer.

No draft wagon of 1-ton capacity or more, having metal tires less than 3 inches wide, may be sold in the State under penalty of a fine of from \$5 to \$25 for each sale.

### Bond Legislation

Township boards may issue bonds in an amount not exceeding 5 per cent of the value of the taxable property in the township, upon a three-fifths vote of the electors voting at a special election. The interest cannot exceed 6 per cent and the term must not



exceed 25 years. An annual tax must be levied to pay the interest and to create a sinking fund for the redemption of the bonds.

County commissioners are authorized, upon a three-fifths vote of those voting at a special election, to issue county bonds in an amount not greater than 5 per cent of the assessed valuation and for a term not exceeding 25 years for building, or acquiring bridges, or building roads surfaced with gravel, stone or other hard material. An annual tax is levied to meet the interest and sinking fund charges on the bonds. All work done under a bond issue must be performed under an engineer designated by the State highway commissioner.

### **Convict Labor Laws**

State convicts are required to be worked on public highways as continuously as possible. The State board of public affairs furnishes tools, machinery and draft animals. The cost of quarters, food, medical attendance and guards is borne by the prison funds. A county using convict labor pays all charges for transportation, feed for animals, board for guards, supplies for machinery, excess cost of feeding prisoners above average cost at penitentiary, and materials for construction. The State board of public affairs formulates the regulations for governing the convicts and the State corporation commission establishes the transportation rates for moving them. The State board of public affairs may furnish convicts for county road work under certain restrictions. In 1918 seven crews with a total of 480 convicts were employed on road work.

### **Automobile Registration**

Motor vehicles are registered with the department of highways. The fee on passenger cars is \$10 if list price equals \$500 or less; if price exceeds \$500 then add 75 cents for each \$100. List price of 1916 to be used. New cars taxed according to list price at beginning of quarter when license is applied for. Quarterly reduction. Fee for trucks based on carrying capacity 1,500 pounds or less, \$15; 1,500 to 2,000 pounds, \$20; \$5 for each additional 500 pounds quarterly reduction. Nine-tenths of the fees are returned to the counties where cars are owned. The treasurer of each county pays 25 per cent of the fees to all incorporated or chartered cities and towns where cars are owned within their limits and the remainder is divided half and half between the county road maintenance fund for road dragging and the State highway construction fund for use only on permanent construction. These latter funds are handled by the county commissioners.

### Road Funds

The State collects a property tax of 0.25 mill, the proceeds forming the State highway construction fund, but used by the counties for State road construction. Receipts from this fund amount to about \$400,000 annually. Each county may levy a property tax of 0.25 mill or more up to the maximum levy of 8 mills for use on State roads under the board of county commissioners. Any county levying this tax is entitled to receive the money in the State highway construction fund standing to its credit. The townships are authorized to levy a 2-mill tax for road dragging and not over  $1\frac{1}{2}$  mills for construction. The  $\frac{1}{4}$ -mill tax for State roads has proved inadequate and private subscriptions have been made to enable the work to proceed.

Another source of revenue is a "gross production tax" of 5 per cent of the gross value of asphalt and various designated ores and 3 per cent of the gross value of petroleum and natural gas produced in the State. One-sixth of the returns of this tax is given to the counties where oil or minerals are produced for aid in building permanent bridges and roads with a surface of gravel, rock or other hard material.

The State highway department expended during the year 1921 approximately \$10,736,000, which was obtained from the following sources: Federal aid, \$2,636,203.58; State auto tax, \$2,005,000; State  $\frac{1}{4}$ -mill tax, \$395,800; and from county levies and bond issues, \$5,700,000.

For expenditure on road construction and maintenance during 1922, the department expects to have approximately \$21,474,600, obtainable from the following sources: Federal aid, \$5,394,300; State auto tax, \$2,100,000; State  $\frac{1}{4}$ -mill levy, \$400,000; county bond issues voted and sold, \$3,995,000; county bond issues pending levies, etc., \$5,875,000; State and county funds on deposit, \$3,710,300.

### Progress Report

Under State direction there was built during 1921 approximately 100 miles of gravel road, 60 miles of concrete road, and 20 miles of concrete road with "Topeka top." State highway officials have also supervised the maintenance of 20,000 miles of road designated as State highways. During 1922 the State expects to complete 209 miles of gravel road, 30 miles of concrete road, 28 miles of concrete road with Topeka top. The State expects to place under contract 143 miles of gravel road, 26 miles of concrete road, and 1 mile of brick road. This does not include work which may be done by the counties under State supervision. The total road mileage in the State is about 120,000.

Experience has proven the impossibility of maintaining under modern traffic conditions earth or even sand-clay roads in a



county where 90-day dry spells are almost annual occurrences, and plans are being formulated calling for surfacing of at least one-third of the State road system. It is on this system that Federal-aid funds are being expended. It is not expected to complete this plan for several years.

### State Highway Officials

Commissioner of highways, Brent E. Clark; State engineer, Ernest S. Alderman; assistant State engineer, Frank Herrmann; division engineers, J. F. Rightmire, Dudley Jones and J. T. Ervin; bridge engineer, Walter C. Burnham. Headquarters, Capitol Building, Oklahoma City, Oklahoma.

Revised by Ernest S. Alderman, State engineer.

## OREGON

### State Highway Legislation

The State highway commission is composed of three members appointed by the governor, one from each congressional district, to hold office for three years, one commissioner's term expiring each year. The commissioners are allowed their actual traveling expenses while on official business, but receive no salary.

The commission has general supervision over the construction and maintenance of State highways, decides on their definite location, adopts standards of construction, approves specifications and plans, awards contracts, selects materials, and decides on type of road and bridge structures. It appoints the State highway engineer, who receives a salary of \$7,200 per year, together with actual traveling expenses, and employs such other assistants at such salaries as may be necessary. The State highway commission, the engineer and other employees constitute the State highway department.

The total mileage of public roads in the State is 42,000 miles, of which approximately 4,500 comprises the State system. The roads in the system are maintained under State supervision, the costs being borne equally between the State and counties. It is also empowered to cooperate with the counties and the Federal government in State highway construction, to purchase or contract for supplies or equipment, or undertake construction work with its own forces. It may condemn right-of-way across private property and may acquire, by condemnation, titles to land upon which road materials are located.

The highway engineer directs the work of surveys and the preparation of plans, specifications and estimates, and acts in an advisory capacity to county courts. Surveys, plans and estimates for State highways are furnished free to county courts. All

construction work done by counties on State highways, to which the State contributes not less than 25 per cent, is subject to the supervision of the State highway department.

*New Legislation.*—The 1921 legislature enacted a law authorizing the formation of highway improvement districts for the purpose of constructing highways within their boundaries. These districts may be as large or as small as may be desired. The law provides that these districts may bond up to 10 per cent of their valuation for this purpose. The boundaries of the highway district must be approved by the highway commission. It is anticipated that several districts will be formed during 1922.

### Local Highway Legislation

Road and bridge affairs in the county are administered by a county court composed of a county judge and two commissioners, elected for a term of four years.

#### STATE HIGHWAY BONDS AUTHORIZED AND SOLD

	Amounts Authorized	Sold to date Nov. 30, 1921	Balance Unsold Nov. 30, 1921
To meet Federal Aid, 1917 and 1920.....	\$ 6,206,799	\$ 4,700,000	\$1,506,799
Six Million Bonds 1917.....	6,000,000	5,440,000	560,000
Ten Million Bonds 1919....	10,000,000	10,000,000	0
Ten Million Bonds 1920....	10,000,000	10,000,000	0
Seven Million Bonds 1921 ..	7,000,000	0	7,000,000
	<b>\$39,206,799</b>	<b>\$30,140,000</b>	<b>\$9,006,799</b>

All State bonds mature one-twentieth each year, beginning with the sixth year after issuance, except \$1,200,000 Federal-aid co-operation bonds, which mature \$100,000 per year beginning 1922.

The constitutional debt limit for State highway purposes is 4 per cent of the assessed valuation. For 1922 the limit is \$40,-832,167.88.

In addition to the State bonds, counties may issue road bonds not to exceed 6 per cent of their assessed valuation. Since 1913 all of the counties, except three, have issued bonds, the aggregate of which is \$21,297,944.

### Convict Labor Laws

The State highway commission may authorize and provide for the construction of any State road or part thereof by convict labor. Upon the written request of the county court of any



county, the governor may detail from the State penitentiary such convicts as in his judgment may seem proper for use on public highways. They are delivered to the county court on such terms and conditions as are prescribed by the parole board and approved by the governor. No convicts have been used upon State or county road work for the past eight years, employment within the prison walls being preferred by the penitentiary authorities.

### Automobile Registration

Registration license fees are paid annually to the Secretary of State. The fees for passenger cars are based on weight. The rate amounts to \$15 for vehicles weighing 1,700 pounds or less, with \$6 to \$7 additional for each 400 pounds of weight up to \$97 for vehicles weighing 5,700 pounds. One-quarter and one-half rates are allowed for fractions of the year. The rates for motor bicycles are \$3, motorcycles \$6, and motorcycles with sidecars \$9.

The rates for motor trucks, trailers and semi-trailers equipped with one or more solid tires are based on the total tire width of such vehicle according to the following schedule:

	Motor trucks	Trailers and semi-trailers
Less than 14 inches and not over 14 inches.....	\$35.00	\$17.50
Over 14 inches and not over 17 inches.....	42.00	21.00
Over 17 inches and not over 22 inches.....	55.00	27.50
Over 22 inches and not over 26 inches.....	65.00	\$32.50
Over 26 inches and not over 30 inches.....	105.00	52.50
Over 30 inches and not over 36 inches.....	126.00	63.00
Over 36 inches and not over 40 inches.....	140.00	70.00

The rates for motor trucks, trailers and semi-trailers, when equipped with four pneumatic tires, are based on the total tire width of such vehicles, according to the following schedule:

	Motor trucks	Trailers and semi-trailers
Less than 20 inches and not over 20 inches.....	\$35.00	\$17.50
Over 20 inches and not over 24 inches.....	42.00	21.00
Over 24 inches and not over 28 inches.....	49.00	24.50
Over 28 inches and not over 32 inches.....	56.00	28.00
Over 32 inches and not over 40 inches.....	70.00	35.00

Motor busses pay \$4 for each passenger, in addition to the fees prescribed according to the weight of the motor vehicle, at the

rated passenger capacity, allowing twenty inches of seating capacity space for each passenger.

Motor trucks, trailers and semi-trailers used in the business of transporting freight or any article of commerce for hire and not operating exclusively within the limits of an incorporated city or town, pay for each inch or fraction thereof of total tire width at the rate of 50 cents per inch, in addition to the other fees prescribed by law for motor trucks, trailers and semi-trailers; provided, that on application the secretary of State may in his discretion grant a permit to use oversize tires on motor trucks not exceeding two tons capacity, for the purpose of securing traction and not for the purpose of increasing the combined weight and load capacity, and no charge in excess of the regular license and tire width fees provided for regular equipment shall be made.

In this State there is no property tax on motor vehicles.

No total load, including weight of vehicle, exceeding 22,000 pounds, or more than 600 pounds per inch width of tire, is permitted.

The regulation of motor bus, State and commercial freight truck lines is under the supervision of the public service commission of the State.

### Road Funds

*State Funds.*—There is no direct State property tax for State highway work. The State highway fund consists of the proceeds from the authorized bond sales, the receipts from the 2-cent-per-gallon gasoline tax, which amounts to approximately \$1,000,000 per year, and also the fees from the licensing of motor vehicles less the cost of administration and less the 25 per cent returned to the counties.

In 1921 there was a registration of 118,615 motor vehicles, and the total income to the State highway fund amounted to \$1,629,000.

*Federal Funds.*—The total Federal-aid funds allotted already for post roads, including the 1921 enactment, totals \$5,514,000, and the Federal funds for forest roads, including also the 1921 enactment, totals \$3,054,000, but not including funds made available to the forest service for roads and trails in the State.

*County Funds.*—Either bonds or tax money is used frequently in coöperation with the State on State highway construction, principally grading and bridges.

*Market Road Funds.*—A State tax of 1 mill is levied on all taxable property of the State for market road purposes, which is apportioned to the various counties which raise an equal amount. The law provides that no county shall receive greater than 10 per cent of the total, so there is a surplus of approximately \$250,000 to be divided among the smaller counties. The total State market



road appropriation in 1921 was \$1,020,563, which was matched by an equal amount from the counties.

## Progress Report

### *Progress Report (72)*

#### *Mileages of Work Completed:*

Concrete paving.....	51.0
Bituminous paving.....	125.0
Rock and gravel surfacing.....	433.9
Grading.....	449.7

#### *Mileages of Work Contracted:*

	Carried over from 1920 contracts	Contracted 1921	Totals
Concrete paving.....	21.8	41.3	63.1
Bituminous paving.....	36.7	121.5	158.2
Rock and gravel surfacing....	228.9	326.5	555.4
Grading.....	174.8	411.7	586.5

#### *Total Expenditures:*

State funds.....	\$15,031,655.14
Federal Government funds.....	2,181,856.65
County funds.....	985,831.42
Railway funds.....	46,378.16
Total.....	\$18,245,821.37

#### *Income from Different Sources:*

Sale of bonds.....	\$10,957,359.33
Motor Vehicle license fees.....	1,629,274.70
Gasoline and distillate tax.....	948,509.66
Interest on bank balances, warrants, etc.....	14,992.71
Balance from 1920.....	1,822,589.86

The work completed by the State highway commission since 1917 to date gives the following totals: 585 miles graded and paved; 763 miles graded and surfaced with rock or gravel; 215 miles graded ready for surfacing.

It is anticipated that the State highway commission expenditures will total \$10,000,000 in 1922 and the counties will expend probably an equal amount, as an improved bond market has made it possible to sell many county bond issues which it has been impossible to sell previously on account of the prohibition against the sale for less than par. This, it is estimated, will make about \$5,000,000 available in addition to the regular road tax levies.

### State Highway Officials

R. A. Booth, Eugene, chairman; members, John B. Yeon, Portland, commissioner; W. B. Barratt, Heppner, commissioner; Herbert Nunn, State highway engineer; Roy A. Klein, secretary of the commission and assistant State highway engineer.

Headquarters, State Capitol Building, Salem, Oregon.

Revised by Roy A. Klein.

## PENNSYLVANIA

### State Highway Legislation

The present organization of the State highway department embraces five divisions, namely, executive, construction, maintenance, township and automobile, each of which performs a special service not common to any other branch of the department; also seven service divisions and bureaus, namely, auditing and accounting, equipment, contract, purchasing, filing and mailing, stenographic, typing and duplicating, and extension, each of which performs the same service for all branches of the organization. In addition there is a coördinating branch known as the management division.

Under the administration of Governor Sproul and State Highway Commissioner Lewis S. Sadler, who died January 20, 1922, the State laid down a primary system of roads. In planning this system the State highway department ignored the factor of assessed valuation and county lines, and designated a trunk-line system, connecting the centers of consumption with the centers of supply, and connecting also with road systems of adjacent States. The entire cost of the improvement of this system, which comprises 3,900 miles, was assumed by the State, the counties being urged to use their available funds in the construction within their limits of the secondary road system, this constituting roads of great local importance, but not used by the public as a whole. Pennsylvania was the first State in the Union definitely to lay out such a system, and was also the first State to plan a construction program to be followed year by year without deviation.

The legislature of 1921 passed a number of acts affecting the State highway department and the State's road construction program. The more important of these acts are as follows:

Permitting the State highway commissioner, instead of the governor, to appoint an assistant State highway commissioner, a township commissioner and a chief engineer, and to fix the salaries of all officials and employees of the department, except that of the State highway commissioner; amending the act of July 8, 1919, creating a division of township highways and imposing certain duties upon the offices of that division; providing that town-



ships of the first class may improve additional widths of State highways when a defined width of such highway is being or has been permanently improved by the State highway department; providing that the improvement and maintenance of highways by counties shall be approved by the State highway department; relating to the erection of road signs by township commissioners or supervisors; prohibiting the imitation or mutilation of State highway department signs; relating to apportionment among and forfeiture by counties of State-aid funds; rewards for improvements of township highways; providing for the marking of roads used as detours; providing for a tax of 1 cent per gallon on gasoline and appropriating half of the sum collected in each county to that county for highway work; relating to the maintenance and improvement of highways by counties; providing that townships of the first class may construct sidewalks along township highways.

The legislature of 1919 changed the system of distributing bonus funds to townships. Under an old act the State gave to townships a sum of money to equal 50 per cent of the amount of cash tax collected, but not exceeding \$20 per mile. The 1919 act changes the proposition to one of rewards, the sum of \$1,000,000 being appropriated as rewards to townships for improvements actually made of a permanent character. The rewards may be withheld upon neglect of supervisors to carry out the instructions of the township commissioner of the State highway department.

Legislation of 1919 also simplified the methods by which boroughs may secure State aid. State aid is granted for improving State and other highways. Counties, townships or boroughs which desire it can proceed in the following manner: The township supervisors or commissioners or borough council of the township or borough in which the road lies shall first make petition to the county commissioners and it shall then be the duty of the county commissioners to adopt a resolution assuming on behalf of the county its share of the cost of the proposed improvement. The county commissioners shall then petition the State highway department for State aid, the cost of the improvement to be prorated among the townships or boroughs, the county and the State, the State paying 50 per cent of the cost of reconstruction, the county and townships or borough the other 50 per cent. If either the township, county or borough desires to act independently of the others, it makes application directly to the State highway department and agrees to assume 50 per cent of the total cost. The State pays 50 per cent of the cost of maintenance on all roads other than State highway routes; the other 50 per cent is paid by the township. Boroughs must assume all maintenance costs. The State-aid fund is apportioned among the several counties of the State according to the mileage of roads in each county.

The act of July 8, 1919, created a division of township highways in the State highway department. Under its terms the township commissioner has general supervision of all township highways and bridges constructed, improved or maintained by the aid of State moneys, except State and State-aid highways. He approves all agreements made by township supervisors for the expenditure of moneys appropriated by the State or the township for road purposes. He also approves plans, specifications and estimates for the erection or repair of township bridges, culverts and highways, as well as compels compliances with laws and regulations relating to such highways and bridges.

In 1913 a maintenance department was established under the direct charge of a maintenance engineer, with a view of standardizing and systematizing all maintenance work under the jurisdiction of the highway department. This division is now so systematized that the operation of each unit of the maintenance force in the field is reflected in this department immediately upon the expenditure of any money, and each dollar expended is so recorded that the department can locate, by referring to station numbers reported, the 100 feet upon which expended and for what used.

The State highway department also maintains an extension bureau which has charge of the department's publicity and also furnishes information on a wide variety of subjects. Weekly bulletins are issued detailing the location of detours.

### Local Legislation

Jurisdiction over local roads vests in counties, in boards of county commissioners; first-class townships, in township commissioners; second-class townships, in three supervisors of roads.

### Bond Legislation

*State Bond Issue.*—The voters of the State in November, 1918, approved a proposition to bond the Commonwealth for \$50,000,000 for road-construction purposes. The legislature by an act approved April 18, 1919, enacted the legislation necessary for the flotation of these bonds. The entire \$50,000,000 worth of bonds will have been issued prior to January 1, 1923. From the proceeds of the bonds the State highway department is constructing the primary highway system.

The State highway department in its awarding of contracts has insisted upon building only those roads which will stand up not only under present-day traffic, but the traffic of the future. It is planned that the roads constructed from this bond issue shall be of such type as with proper maintenance will be in exist-



ence long after the bonds have been paid off. The types of construction chosen for the system are those best suited for the particular stretches under construction and were selected only after a careful study of the territory to be surveyed, the availability of materials and the traffic which will use the road.

*Local Bond Legislation.*—During 1919, 1920, and 1921 various counties of Pennsylvania authorized bond issues aggregating about \$40,000,000, the money to be spent on the construction of secondary highway systems which connect with the State's primary highway system.

The county commissioners of the several counties may borrow money for improving and maintaining the public roads and may issue bonds for these improvements. The amount may not exceed in the aggregate 7 per cent of the total of the assessed valuation of all property in the county at the last triennial valuation.

### Convict Labor Laws

All male persons sentenced to county jails and workhouses may be assigned to work on public roads by the prison board. No convict labor was used by the Commonwealth in 1919.

### Automobile Registration

The fees are as follows: Passenger motor vehicles, 40 cents per h. p., with a minimum fee of \$10; motorcycles, \$3; bicycle with motor attached, \$2; commercial motor vehicles with chassis weighing less than 2,000 pounds, 40 cents per h. p., with a minimum fee of \$15.

In the case of commercial vehicles having a greater chassis weight than 2,000 pounds the rates are as follows:

<i>Chassis Series</i>	<i>Pneumatic Tire</i>	<i>Solid Tire</i>
2,000-3,000 lbs.	\$24	\$30
3,000-4,000 lbs.	32	40
4,000-5,000 lbs.	40	50
5,000-6,000 lbs.	56	70
6,000-7,500 lbs.	80	100
7,500-8,500 lbs.	100	125
8,500 and over	140	200

Tractor trucks with semi-trailer attachments are registered according to the above table upon the basis of the chassis weight of tractor plus the weight of semi-trailer attachment; electrically operated commercial motor vehicles, same fee as for pneumatic tire commercial motor vehicle; motor vehicles and trailers with metal tires, double the regular fee for such vehicles and no half fee after August 1; trailers weighing less than 500 pounds, no registration required; trailers between 500 pounds and 2,000

pounds, from \$2 to \$15; traction engine or tractors, first class, \$5; traction engine or tractors, second class, \$50; tractor trailers, from \$5 to \$25, depending upon weight of trailer and load combined; motor vehicle dealer, \$10.

### Road Funds

Appropriations to the State highway department of Pennsylvania for the two years beginning with July 1, 1921, were as follows:

General salary and expense.....	\$ 3,330,000
State highway construction .....	2,750,000
State-aid highway construction .....	4,000,000
Maintenance and repair boro. aid.....	500,000
Maintenance and repair State aid.....	500,000
Salary, State highway commissioner.....	20,000
Township reward .....	1,000,000
Property damage .....	20,000
	<hr/>
	\$13,120,000

The receipts from automobile license registrations during 1921, which are used entirely for the maintenance of State Highways, were \$9,460,895.35.

During 1921 the State highway department completed the construction of 670 miles of durable highway, into which concrete entered in some form.

### State Highway Officials

State highway department, Harrisburg.—George H. Biles, assistant State highway commissioner; Joseph W. Hunter, township highway commissioner; Colonel William D. Uhler, chief engineer; Howard W. Fry, secretary; Harold E. Hilts, principal assistant engineer; Horatio S. Mattimore, engineer of tests; Paul M. Tebbs, construction engineer; George H. Elsenhans, engineer of plans and surveys; Emory E. Brandow, bridge engineer; R. V. Warren, township engineer; W. A. Van Duzer, assistant maintenance engineer; W. S. Hammaker, maintenance inspector; George W. Deaves, maintenance inspector; Benj. G. Eynon, registrar of motor vehicles; John C. Hildebrandt, comptroller; George G. Hatter, executive manager; M. H. James, director, extension bureau.

The office of State highway commissioner is vacant since the death, January 20, 1922, of Lewis S. Sadler of Carlisle.

Revised by M. H. James.



## PHILIPPINE ISLANDS

Under an Act of Congress, approved August 29, 1916, the governor-general is the executive and administrative head of the insular government. The secretary of commerce and communications, a member of the governor-general's cabinet, is in general charge of roads. Design, construction and maintenance of all roads and bridges throughout the islands are in the hands of the bureau of public works, except for city streets and a few unimportant barrio roads and trails. The field work of the bureau is distributed through the 49 provinces.

### Progress

At the close of 1920 there were 4,698 kilometers of first-class roads, well graded and surfaced, and thoroughly drained; 2,037 kilometers of second-class roads, fairly graded and partially or naturally surfaced; and 3,079 kilometers of third-class roads, or traffic routes for carts not included in the first and second-class roads. During the year there were constructed 200 kilometers of first-class roads.

At the present time practically every province now has a single connected system radiating from the provincial capital. The extension of the first-class road system is being continued in all the provinces.

Among the most important road construction projects undertaken during the year, the following may be mentioned, as having been completed or now still under construction:

Interprovincial roads, connecting Pandam, Antique and Navas, Capiz, San Joaquin, Iloilo and San Jose, Antique; Pilar, Capiz and Balasan, Iloilo; Isabela, Occidental Negros and Guijulan, Oriental Negros; Albay and Sorsogon; Bolboc, Batangas and Candelairia, Tayabas; Para, Tarlac and Guimba, Nueva Ecija; Dinalupihan, Bataan and Subic, Zambales; San Jose, Nueva Ecija and Santa Fe, Nueva Vizcaya; Bangued, Abra and Ilocos Sur; Bangui, Ilocos Norte and Claveria, Cagayan.

Provincial roads, connecting Capiz with Dumarao, Province of Capiz; Logo with Taboitan, or the east and west coasts of the northern part of the Island of Cebu; Danhagon canal with Daan-Bantayan, Province of Cebu; Lucban, Sampaloc and Mauban, Province of Tayabas; Tiaong and Dolores, Province of Tayabas; Panaon and Unisan, Province of Tayabas; Tarlac and Camiling, Province of Tarlac; San Fernando and Poro, Province of La Union; Camp One and Aringay, Province of La Union.

### Maintenance

All of the first-class roads mentioned are constantly maintained, every square meter thereof coming daily under the eye of a caminero. The second-class roads are generally intermittently maintained. The average number of kilometers maintained, and the total cost of road maintenance during the year 1920, under the two systems in vogue in the islands are given below:

Caminero (cantonier or patrol) system .....	4,601.3 km.	3,197,202.28
Gang system .....	3,030.1 km.	945,351.19

Type of surface: Stone, 1,429.8 km.; gravel, 3,059.4 km.; coral, 1,450.5 km.; unsurfaced, 3,876.4 km.

### Road Funds

The funds expended in the islands during 1920 on roads and bridges, which amounted to 7,456,498.77 pesos, were purely local funds, insular, provincial and municipal.

### Motor Vehicles

The licensing of motor vehicles is in the hands of the bureau of public works, and also the operation of the Benguet automobile line, which operates over the Benguet and Naguilian roads. The revenues from both these sources are generally allotted to special maintenance projects.

At the close of 1920, there were 13,493 motor vehicles registered in the islands, a gain of 4,149 over 1919. Receipts from registrations amount to 177,643.24 pesos.

### Highway Officials

Director of public works, Jose Paez; chief of designing engineer, Earl C. Earle; chief constructing engineer, Marcial Kasilag. Main office, Manila.

Revised from information furnished by the Bureau of Insular Affairs, War Department.

### PORTO RICO

The governor exercises supreme executive power over the island, and the commissioner of the interior has charge of all insular public works. The political code of Porto Rico subdivides the latter's office into various divisions and bureaus, of which the bureau of public works is intrusted with highway affairs.

The main roads of the island are 1,300 kilometers long. Of this total 275 kilometers were built by the Spanish government,



141.7 by the United States military government, and 883.4 kilometers by the civil government. These roads cross the island in all directions and reach all cities and towns. Most of them are good automobile roads.

### **Road Funds**

During the fiscal year 1921, \$995,174.76 were spent for the construction of insular roads and bridges, while \$905,423.91 was spent for maintenance. These funds were provided by special appropriation of the legislature, except \$877,962.16 derived from a \$2,000,000 bond issue authorized for road and bridge construction in 1916.

### **Progress**

There was completed during the year 38.1 km. of macadamized road and ten reinforced concrete bridges having a length of 246.5 linear meters.

For the purpose of maintenance, the island is divided into 11 districts, with one general inspector, 11 road overseers, 8 assistant road overseers, and 51 foremen in charge. Each district is divided into sections of 25 km. attended by a foreman who reports directly to the overseer. Each section is further subdivided into 3 or 4 km. sections having a road mender in charge. There are 411 of these road menders. There are now 1,265.5 km. of roads being maintained at an average cost of \$715.50 per km.

### **Automobiles**

The licensing of automobiles is in the hands of the division of disbursements and accounts, department of the interior, San Juan, Porto Rico.

At the close of the fiscal year 1921 there were 6,791 automobiles registered in the island. The registration fees amounted to \$141,-143.30.

### **Officials**

Governor, E. Mont. Reily; Commissioner of the Interior, John A. Wilson.

Revised from information furnished by the Bureau of Insular Affairs, War Department.

## **RHODE ISLAND**

### **State Highway Legislation**

The State board of public roads, consisting of five persons, one from each county, is appointed by the governor for a term of five years. The board has direct control of the expenditure of all appropriations by the legislature for road improvement, and has

supervision over the construction and maintenance of all State roads.

The entire cost of construction and maintenance of State roads is paid by the State. There is in Rhode Island exclusive of the roads and streets in municipalities a total of 2,368 miles of public highway. The State highway system as approved by the legislature comprises 716 miles. Upon January 1, 1922, a total of 348 miles of road had been built by the State.

A State bond issue of \$600,000 was authorized in 1906 to bear 3 per cent interest and additional bond issues of \$600,000 were made in 1909 and 1912 for use in completing the system of State roads. No more than one-third nor less than one-seventh of the available appropriation in any year is expended in any one county. The proceeds of automobile licenses and fines are used for the repair of State roads under the direction of the State board.

In addition to the State highways, State aid is granted as follows: Whenever any town shall make an annual appropriation equal to or in addition to the sum of 20 cents on each \$100 of taxable valuation, and whenever the electors shall vote that the appropriation be expended under the direction of the State board of public roads a sum equal to one-fifth of the moneys so appropriated by any town is annually appropriated by the State for the care and maintenance of the public highways and bridges of the town. At the close of 1918 there were 1,795 miles of town roads.

In 1912 legislation was enacted providing that bridges on State roads shall be under the control of the State board of public roads.

At the January session, 1917, the general assembly passed a resolution assenting to the provisions of the Federal aid act and appropriated \$174,985.65 to meet an equal sum apportioned by the secretary of agriculture to the State. At the January session, 1919, the general assembly assented to the amended Federal aid act and appropriated \$466,123.81 in addition to the amount previously appropriated to meet an equal sum apportioned by the Secretary of Agriculture.

### Local Legislation

The local roads are under the town council of the township, who usually appoint a highway commissioner to look after the roads. There are no county road organizations in Rhode Island. During 1921 it is estimated that approximately \$400,000 was spent for roads by townships and that approximately \$1,800,000 was spent upon roads and streets in cities.

### Automobile Registration

Motor vehicles are registered annually with the State board of public roads. The fees are as follows: Motor vehicles equipped



with pneumatic tires, 25 cents per h. p. plus 25 cents per 100 pounds gross weight of vehicle and load. For solid rubber tired vehicles the rate is 25 cents per h. p. plus 35 cents per 100 pounds. For vehicles equipped with iron or steel tires the rate is 25 cents per h. p. plus 50 cents per 100 pounds. For automobiles used for the purpose of transporting persons for hire the rate is double those given above. For trailers the rate is 15 cents, 25 cents and 35 cents per 100 pounds for vehicles equipped with pneumatic tires, solid rubber tires and iron tires, respectively. The rate for motorcycles is \$5.

The revenue derived from registrations, fines and forfeitures is paid into the State treasury to be used for the repair and maintenance of State roads under State direction.

### Receipts and Expenditures

The State board had for the year 1921, receipts from a special State road tax of three-tenths mill, \$300,000; automobile registration, \$850,000; appropriation, \$300,000; detour account, \$10,000; balance of bridge loan of 1921, \$286,000; total, \$1,746,000 exclusive of Federal aid. Total expended, \$1,610,000. Estimated total available during 1922, \$1,800,000 exclusive of Federal aid. Total Federal aid fund of 1917-19, \$1,282,000; expended, \$1,063,000.

### Progress Report

During 1921, 36 miles of worn-out macadam was reconstructed or contracted for; 28.2 miles of new State road constructed or contracted for; 9 miles of waterbound macadam on secondary routes resurfaced; and 14 miles of narrow bituminous roads widened.

A program involving the expenditure of all funds available under the Federal-aid Road Act of 1916 is complete. There is a total of twelve projects involving a total mileage of 38.72. Eleven projects have been completed and the twelfth is under construction.

Upon January 1, 1922, the completed State highway system consists of 348.2 miles of the following types of construction: Macadam, 157.71 miles; bituminous macadam, 61.87 miles; bituminous concrete, 121.59 miles; concrete, 5.45 miles; sheet asphalt, 1.58 miles.

### State Highway Officials

State board of public roads, Providence: Abram L. Atwood, Benjamin F. Robinson, Frank Cole, Alton Head, J. Henry Woodward, members of the board; Irving W. Patterson, chief engineer; George R. Wellington, chief clerk.

Revised by G. H. Henderson, office engineer.

## **SOUTH CAROLINA**

### **State-Aid Legislation**

The State highway commission is composed of seven members, one from each congressional district. They are appointed by the governor, three for four years, and four for two years, but their successors are to be appointed for four-year terms, thus insuring continuity of the commission. They receive \$100 per annum each, and necessary traveling expenses.

The commission appoints and fixes the salary of a State highway engineer who must be a competent and experienced road builder, and a secretary, not a member of the commission. Technical assistants are appointed and their salary fixed by the State highway engineer, while clerical assistants are employed by the secretary, both with the approval of the commission.

The commission is authorized to lay out a system of State highways connecting every county seat in the State. Roads on the border counties are also to be connected with important roads in adjoining States. This system includes 3,300 miles, or 6.6 per cent of the total mileage of the State about 50,000 miles. The construction of these roads is paid for by the counties out of a State-wide levy of 2 mills, the funds being retained by the counties in which collected, but expended under the direction of the State highway department. All roads in the system which have been completed in accordance with State standards and under State direction are maintained by and at the expense of the State from the motor vehicle fund, the amount being deducted by the State for that purpose.

Federal-aid funds are expended with county funds on the State highway system. When local authorities request Federal aid, plans, specifications, and estimates are prepared by and at the cost of the State. The work is done by the counties by contract, force account, or prison labor, and under the inspection and supervision of the State highway department. When completed the roads are maintained by the State. The cost of construction is borne 50 per cent by the counties and 50 per cent by the Federal aid fund.

### **Local Legislation**

Except where special laws apply, the control over roads and bridges in the several counties vests in a county board of commissioners composed of the county supervisor as chairman, elected by the people for a four-year term, and two commissioners appointed by the governor on the recommendation of the county delegation to the general assembly. Some counties have, by law, more than two commissioners and several counties operate under special laws. District overseers have immediate control over the



roads in the various townships. They are appointed by the county board, or subject to its approval, or by the township board of commissioners in counties where such boards exist.

### **Bond Legislation**

There is no general law authorizing the issuance of road and bridge bonds. Such bonds are authorized by special acts of the legislature.

County bonds authorized in the past three years amount to \$19,888,000.

County bonds authorized in the past seven years amount to \$25,275,000.

County bonds issued in the past seven years amount to \$15,727,000.

### **Automobile Registration**

For passenger cars the rate, in lieu of all other taxes, is as follows: Not over one ton, \$6, plus \$2 for each 500 pounds or fraction over that weight.

For trucks the fees are as follows: 1 ton, \$15; 2 tons, \$30; 3 tons, \$60; 4 tons, \$100; 5 tons, \$200; 6 tons, \$250; 7 tons or over, \$350, with reduction of 25 per cent of these rates if equipped with pneumatic tires.

### **Road Funds**

From the 2-mill State-wide tax and from 80 per cent of the automobile license fees there were expended for construction on the State system under State direction \$251,500 during 1921. It is expected that the total amount to be expended from the same source and for the same purpose will amount to \$1,000,000 during 1922.

The automobile license fees amounted to \$733,820 during 1921. Eighty per cent of this fund may be expended in the county in which it is collected, first for the maintenance of improved roads on the State system, and second, if any balance remains, for the construction of such roads. The remaining 20 per cent of the motor vehicle fund is retained for the administration of the State highway department. In 1921 the sum of \$340,000 was expended on maintenance.

County commissioners may annually levy a 1-mill tax, the proceeds to constitute a part of the county road fund. They may also levy a similar tax on property in any township on written request of two-thirds of the property owners of the township. An additional levy of 2 mills may be assessed for two-year terms by the county board on any township if agreed to by a majority vote of the electors who own real and personal property subject to tax-

ation. One-half of the taxes derived from the sale or manufacture of timber is used for the improvement of public roads.

### Progress Report

There was completed under State direction during 1921, 29 miles of hard roads and 721 miles of roads surfaced with gravel, top soil, and sand-clay. These roads are being maintained by the State from motor vehicle money accruing to the various counties.

Approximately 750 miles of new construction is planned for 1922, and it is estimated that the State will then have under maintenance about 2,000 miles of State roads which will include every mile of improved road on the State system.

On January 1, 1922, the completed State highway system consisted of 1,460.52 miles of the following types of construction:

Graded and surfaced with topsoil, sand-clay or gravel	
1,375.76 miles at approximate cost of.....	\$5,503,040
Graded and hard surfaced 84.76 miles at approximate cost of .....	2,712,320
Under State supervision in year 1921:	
717.33 miles of topsoil or sand-clay .....	\$2,869,320
4.00 miles of gravel .....	24,000
27.00 miles of concrete .....	864,000
1.67 miles of asphaltic mixed .....	55,110
<hr/> 750.00 .....	<hr/> \$3,812,430

### State Highway Officials

State highway commission: R. Goodwyn Rhett, chairman, Charleston; members, C. O. Hearon, Spartanburg; A. B. Langley, Columbia; R. E. Ligon, Anderson; W. S. Rentz, Varnville; N. G. Walker, Rock Hill; Frank Manning, Jr., Bennettsville; L. H. Thomas, secretary, Columbia; engineering department, Charles H. Moorefield, State highway engineer; R. T. Brown, field engineer; L. M. Weisiger, field engineer; Joseph W. Barnwell, bridge engineer.

Headquarters, Columbia.

Prepared from notes furnished by Charles H. Moorefield.

## SOUTH DAKOTA

### State Highway Legislation

The State highway commission consists of the governor as ex-officio chairman and three other members appointed by the governor at salaries not to exceed \$3,600 per annum each. A State highway engineer is appointed by the commission for a term of four years.



The commission is vested with power to superintend the construction of roads to which State and Federal funds are applied and is authorized to lay out a system of not over 6,000 miles of trunk line highways connecting county seats and cities having a population of 750 or more.

The commission is authorized to apply all State allotments of State and Federal money to the trunk line roads, 75 per cent of all State and Federal funds being apportioned to the various counties on the basis of assessed valuation and the remaining 25 per cent being expended at the discretion of the highway commission after deducting the necessary expenses for the maintenance of the commission.

### **Local Roads**

Jurisdiction over county roads is vested in boards of county commissioners and the county highway superintendent. A county highway system of primary roads is laid out in each county and is built and maintained by the county highway superintendent, in accordance with the plans and specifications furnished by the State highway commission. County boards may levy a 2-mill tax, and when authorized by a majority vote, this may be increased to 5 mills. Nearly all counties levy the full legal limit of 2 mills. Secondary roads are constructed and maintained by boards of township supervisors from funds derived from direct taxation at not to exceed 50 cents on each \$100 of assessed valuation. A poll tax may be levied at the rate of \$1.50 per capita, which may be worked out.

### **Bonds**

Sinking-fund bonds may be issued by county boards in amounts not exceeding 5 per cent of the total assessed valuation when authorized by three-fourths of the electors of the county. Such bonds shall become due in not less than 20 years from the date of issue, and they may bear interest at rates not exceeding 5 per cent.

Bonds may be issued by township boards in an amount not exceeding 5 per cent of the total assessed valuation of the township, and in no case to exceed \$5,000. Such bonds may bear interest at a rate not exceeding 10 per cent, and may not run more than 20 years. No county or township bonds are outstanding in South Dakota.

### **Convict Labor Law**

When in the opinion of the sheriff any convict sentenced to hard labor can be more profitably employed outside of the jail or yard, it is his duty to employ him either in work on public streets or highways or otherwise.

### Automobile Registration

Automobiles are registered annually with the secretary of State through county officials. License fees, automobiles, \$6, trucks, 2-ton capacity or less, \$6; 2 to 3½ tons, \$10; 3½ to 5 tons, \$15; motorcycles, \$3; dealers, including number plates (3 sets), \$25; motorcycle dealers' licenses, \$5; 10 per cent of the fees are paid to the secretary of State to pay for issuing licenses, while 90 per cent remains with the county in which the license is issued to be used in maintaining roads. There is also a gasoline tax amounting to 1 cent per gallon all of which is placed to the credit of the State highway fund.

### State Road Funds

Funds for State highway purposes aside from Federal aid and county contributions are derived from three sources approximately as follows: State tax 1/10 of a mill \$206,460; gasoline tax 1 cent per gallon amounts to about \$250,000; State bonds authorized but not yet sold \$1,000,000.

County road levies during 1921 amounted to \$6,956,715.

### Progress Report

Up to January 1, 1921, there had been completed 21 miles of Federal aid gravel roads and 12 miles of earth road. At the beginning of the calendar year, 1922, there was under construction 18 Federal aid projects involving 235 miles of gravel road, also 31 projects involving 320 miles of earth road. There was finished or under construction 11 miles of State aid gravel road during 1921 and 1,216 miles of earth road. The program for 1922 provides for the building of about 200 miles of road most of which will be gravelled.

### Maintenance

All roads in the State, including Federal aid and State aid projects, are maintained by the counties from funds obtained from direct levies and from 90 per cent of the automobile registration fees which are reserved by the counties for this purpose.

### State Highway Officials

W. H. McMaster, chairman; Andrew Marvick, M. L. Shade, and C. N. Leedom, commissioners; George H. Henry, secretary; F. D. Hudgins, highway engineer; J. E. Kirkham, bridge engineer; C. J. Loomer, engineer of tests.

Revised by G. A. Crayton, assistant highway engineer, Pierre, S. D.



## TENNESSEE

### State Highway Legislation

The present form of the State highway department was authorized in 1919. The department is under the control of three paid commissioners, one from each of the three grand divisions of the State, one appointed every two years to serve a term of six years. They are required to devote their whole time to the affairs of the department. The commission elects from among its members a chairman and secretary. At present, one of the members is an experienced engineer, the commissioner of engineering, although this office is not established by law.

Under the Act of 1919 the commission was required to prepare a general highway plan for the State, which, when completed with Federal aid or State aid funds, with or without local funds, would form a connected State system of roads comprising approximately 3,837 miles, of which under the 1921 Federal highways act is divided into primary, 1,618 miles and secondary, 2,219 miles.

The State usually provides from State funds not less than one-sixth of the cost of road construction, the county one-third or less. The county maintains all second-class roads, viz., chert, gravel or waterbound macadam, while the State maintains all roads of higher type. All Federal-aid funds are expended on the designated State-wide system.

### Local Legislation

The administration of the roads in each county varies according to the particular act of legislature applying to the respective counties. Under these acts the local roads may be controlled by the county court, in which case the county is divided into road districts and road commissioners appointed for each district. The commissioner may appoint a road overseer for each district. The county court may also under another special act appoint a board of turnpike commissioners to look after toll roads in the county. Another special act authorizes the county court to delegate these duties to a county road commission of three or more members to have responsible charge of all roads in the county, employing county engineers to have immediate charge of the work wherever it appears desirable.

Counties are authorized to levy a tax on property and on privileges for road purposes. The tax on property varies from 5 cents to 25 cents on each one hundred dollars of valuation and in some counties instead of being paid in money the value may be given by day labor. The tax on privileges is not less than one-fourth the amount assessed for county purposes and not more than two-thirds the amount of this tax may be paid in labor from five to

eight days' labor on the road is required of all male citizens and in two counties the owners of wagons and teams may be required to donate five to eight days' use of these for this purpose.

### **Bond Legislation**

The county court of any county, when authorized by a majority vote at an election held for the purpose, may issue coupon bonds for highway purposes in any amount which will not increase the outstanding indebtedness of the county to more than 10 per cent of the taxable valuation; provided that a two-thirds vote may authorize a bond issue that may increase the outstanding indebtedness of the county to an amount not to exceed 15 per cent. These bonds bear interest at not exceeding 6 per cent, run not more than 40 years, and shall not be sold for less than par. The county courts provide a levy for interest and for retiring the bonds and also for creating an annual maintenance fund equal to 2 per cent of the bonds issued.

To meet Federal-aid the county courts are authorized to appropriate an amount not to exceed double the Federal-aid, and in case there are insufficient funds in the treasury, may issue bonds not to exceed 3 per cent of the taxable valuation.

### **Convict Labor**

County convicts may be worked upon the public highways of the county subject to the direction of the county court. State and county convicts may be worked by the State highway commission. During 1920, 40 convicts were used on State road work.

### **Automobile Registration**

Automobiles are registered with the State highway department. The fees are: Automobiles and motorcycles, 50 cents per horsepower; electric automobiles, \$25 each, and \$5 per ton carrying capacity; motor trucks, freight and passengers, 50 cents per horsepower, plus \$5 per ton carrying capacity.

### **Road Funds**

Tennessee has no bond issue for the construction of highways, but has a State-wide tax of 55/100 of a mill on each \$1 of assessable property from which approximately \$900,000 annually is realized for highway purposes. In addition to this the fees derived from the registration of automobiles amounts to approximately \$1,600,000 after the expenses of collection are taken out. Fifty per cent is retained by the State for highway purposes and 50 per cent is divided equally among the counties of the State to



be expended in highway construction and maintenance under State direction. County contributions to State road work amount to about \$1,800,000 annually.

The total funds available in 1922 for highway purposes from the Federal government, State and counties on Federal-aid projects, including unfinished work let in 1920 and 1921, amounts to approximately \$8,813,944.

In addition to this amount the various counties have authorized bond issues for approximately \$22,000,000.

### Progress Report

During the year 1921 construction was in progress on forty Federal-aid projects aggregating 453 miles of road and one steel truss bridge aggregating \$11,192,103.86. During the year expenditures were made on Federal-aid construction of \$6,462,153.88 in which 188.28 miles of surfacing road was finished which included ten completed Federal aid projects comprising 80.72 miles of road of bituminous concrete, cement concrete, rock asphalt, bituminous macadam and chert surface, also including one bridge at a total cost of \$2,052,270. Additional surveys were completed during the year aggregating 281.3 miles of proposed road at an approximate cost of \$8,073,500.

### State Highway Officials

State highway commission: W. W. House, chairman; W. T. Testerman, secretary; W. P. Moore, commissioner of engineering.

Administration bureau: R. L. Stockard, assistant secretary; auto license division: L. C. Parker, chief accountant; war equipment division, T. C. Hutchinson, superintendent.

Engineering bureau: D. Q. McComb, chief engineer; C. N. Bass, assistant chief engineer; division engineers, No. 1, Knoxville, F. W. Webster; No. 2, Chattanooga, J. E. Moreland; No. 3, Nashville, C. H. Olmstead; No. 4, Jackson, T. C. McEwen; L. W. Erickson, bridge engineer; S. D. Stringfellow, engineer of plans; testing division, O. H. Hansard, John B. Ford.

Revised by D. Q. McComb.

## TEXAS

### State Highway Legislation

The State highway department was organized under provision of the highway act of 1917. It consists of a commission of three members appointed by the governor. The State highway engineer is appointed by the commission and is in administrative control in the absence of the commission, and acts with the highway commis-

sion in an advisory capacity without vote. The commission has designated a system of State highways comprising about 15,000 miles upon which State aid from the State highway fund is granted if the counties agree to contribute one-half to 75 per cent of the cost.

### Local Legislation

Local roads are under the charge of a county commissioner's court. Where the county judge is chairman, he usually appoints a county engineer or superintendent, otherwise, the court makes the appointment.

### Bond Legislation

State—There is no provision for State bonds for road purposes. An amendment to the constitution, voted upon on November 4, 1919, to authorize an issue of \$75,000,000 of State bonds for road improvement, failed to carry.

Local—Any county, political subdivision or other defined district of the county, upon a vote of two-thirds of the resident property-holding taxpayers, may issue bonds for road purposes in an amount not to exceed one-fourth of the assessed value of the real property therein. These bonds shall run for not less than 20, nor more than 40 years, with such option of redemption as may be fixed by the commissioner's court, bear not more than  $5\frac{1}{2}$  per cent interest per annum and must be examined by the attorney-general and registered by the State comptroller of public accounts. A tax must be levied by the county commissioner's court sufficient to pay the interest on the bonds and produce a sinking fund sufficient to redeem them at maturity. The county commissioner in whose precinct the political subdivision or defined district is located is ex-officio road superintendent of the road district with power to let contracts.

The amount of outstanding bonds to December 1, 1917, was approximately \$46,120,000, and on December 18, 1918, totaled to \$51,950,000, while to date, January 1, 1922, there has been voted in Texas a total of \$115,000,000 road bonds by the counties for road construction purposes.

### Convict Labor

The State may use State convicts on the construction of State highways, under an agreement to be made between the State highway department and the prison commission, but this plan has not been tried.

The commissioner's court of counties may require all male convicts, not otherwise employed, to labor upon the public highways under such regulations as may be deemed most expedient. Each convict worked on the roads in satisfaction of any fine and cost



shall receive a credit of 50 cents on each day he may labor and reasonable commutation of time may be granted as a reward for faithful service and good behavior, provided it shall not exceed one-tenth of the whole time.

### **Automobile Registration**

An annual license fee of 35 cents per horsepower is charged for the registration of motor vehicles; minimum annual fee is \$7.50. Trucks with net carrying capacity of more than one ton take a license fee varying from \$16 to \$160, based on their net carrying capacity. All fees are prorated quarterly and are paid to the tax collector of the several counties, one-half the amount of the fees collected being retained in the counties as a special road maintenance fund, the other half going to the State highway department for expenses of the department and road construction purposes.

### **Road Funds**

The department's half of the automobile fees in 1921 amounted to approximately \$1,850,000, and will be about \$2,000,000 in 1922. This fund and Federal aid are the only funds at the disposal of the State.

There is a county property tax of 15 cents on the \$100 for roads and bridges and a special road fund of the same amount may be authorized by a majority vote of the electors. County road warrants may also be issued for road and bridge work.

### **Progress Report**

During 1921 a total of 1,078.5 miles of State highways were constructed at a cost of \$10,637,821.47, of which amount \$6,491,431.62 was State and Federal aid. These completed projects are classified as follows: 70.8 miles of concrete; 131.6 miles gravel or broken stone base with bituminous topping; 117.7 miles of gravel or crushed stone surfacing; 133 miles of sand-clay or shell surfacing; and 25.4 miles of grading and structures only.

Work is now under construction upon 2,040.8 miles, costing \$28,689,449.82, of which amount \$13,281,411.40 is State and Federal aid. The mileage of these projects under construction is classified as follows: 146.6 miles of concrete or brick pavement; 424.6 miles of bituminous pavement; 1,189.7 miles of gravel or macadam; 92.6 miles of sand-clay or shell and 187.5 miles of grading and structures only.

In addition there are 333.3 miles of projects in preparation with an estimated cost of \$3,912,335.75, involving State and Federal aid to the amount of \$1,338,414.74. There has also been further allotted State and Federal aid to the amount of \$6,664,038.47 upon

approximately 1,000 miles of additional improvement work, at an estimated cost of approximately \$13,350,000. All Federal funds available having been definitely allotted.

### **State Highway Officials**

State highway commission: R. M. Hubbard, chairman of commission; W. W. McCrory, commissioner of registration; D. K. Martin, commissioner of construction; Rollen J. Windrow, State highway engineer. Headquarters, Austin, Texas.

Prepared by Rollen J. Windrow, State highway engineer.

### **UTAH**

The State road commission is composed of three members appointed by the governor and confirmed by the senate; salary, \$3,500 per annum.

The legislature designates the roads which comprise the system of State roads which are constructed with State and local funds under the direction of the commission. The percentage of the cost paid by the State is left to the discretion of the commission.

The commission has charge of the expenditure of State road building funds, makes the plans, specifications and estimates and awards contracts for improvement of State roads. The State road engineer, appointed by the commission to hold office for period of four years, is the chief executive official of the commission and has active charge of all construction and maintenance on State roads.

There are 24,057 miles of roads in this State; 3,214 miles have been designated as State roads. Of this State road mileage, on January 1, 1922, there were 137.8 miles of Portland cement concrete; 21.5 miles bitulithic wearing surface on black base; 2.6 miles bitulithic on concrete base; 3.5 miles asphalt; 342.9 miles of gravel or surface treatment; 2,605.9 graded earth or unimproved.

### **Local Legislation**

Jurisdiction over local roads vests in boards of county commissioners. The county commissioners annually appoint the county road commissioner, who has immediate charge of construction and maintenance of county roads.

### **Road Bonds**

State bonds amounting to \$4,000,000, used in meeting the State's share of the cost of State roads, were authorized in 1919. An additional \$1,000,000 was authorized in 1921.



The board of county commissioners may contract bonded indebtedness by an order specifying the purpose for which the indebtedness is to be created and the amount of the indebtedness, and by providing for submission of the proposition to the electors of the county at the next succeeding general election, or at a special election to be called for that purpose. If the bonds are issued, the board levies a tax necessary to pay the interest on them and to create a sinking fund for their redemption at maturity. Bonds shall not be in an amount which, including existing indebtedness, will exceed 2 per cent of the value of the taxable property of the county.

### **Convict Labor**

Convict labor may be utilized in providing road material and also actual construction. Prisoners in county jails may be required to work on the county roads under regulations made by the board of county commissioners, and prisoners in the State prison may be required to work on the State roads. The State board of pardons is required to make provision for granting privileges and reduction of sentence for good behavior on part of convicts employed on roads.

### **Automobile Registration**

Automobiles are registered annually with the secretary of State. The fees are as follows: Passenger cars not exceeding 25 h. p., \$10; 25 to 40 h. p., \$15; 40 to 50 h. p., \$20; over 50 h. p., \$25. Motor trucks, equipped with pneumatic tires, 1 ton or less capacity, \$20; 1½ tons, \$25; 2 tons, \$30; 2½ tons, \$35; 3 tons, \$45; 3½ tons, \$55; 4 tons, \$65; 4½ tons, \$75; 5 tons, \$90. Motor trucks equipped with two or more solid rubber tires, 1 ton or less capacity, \$27.50; 1½ tons, \$35; 2 tons, \$45; 2½ tons, \$55; 3 tons, \$65; 3½ tons, \$80; 4 tons, \$100; 4½ tons, \$120; 5 tons, \$140. Motor trucks equipped with iron, steel or hard tires, 1 ton or less capacity, \$40; 1½ tons, \$60; 2 tons, \$80; for trucks exceeding a load capacity of five tons, the charge shall be \$50 per ton in addition to the five ton rate. Trailers \$10 to \$60, based on capacity and tire equipment.

The receipts from automobile registration fees are paid into the State treasury and are used to amortize and pay the interest on State road bond indebtedness.

### **Road Funds**

There is available in this State for 1922 construction, \$190,957 of State road bonds, which, however, have already been budgeted and apportioned to projects. There is also available \$307,186 in State road taxes of 1921 and \$34,668.03 in State road taxes of

1922. Federal funds available for 1922 construction amount to \$1,838,202. County bonds available, \$973,316. Estimated expenditures for 1922 construction, from all sources, \$2,680,000.

Local road funds are obtained by taxation levied by the board of county commissioners at rates not to exceed 3 mills. Additional funds may be raised by the counties to pay the county's share of the cost of State roads. This additional tax must not exceed 5 mills and is fixed by the State highway commission.

### **Progress Report**

During 1921 there were 91.2 miles of graded earth roads built; 85.7 miles gravel or surface treatment roads; 2.6 miles of bitulithic on Portland cement concrete base; 7.3 bitulithic concrete on black base; 15.16 miles of monolithic Portland cement concrete built at total cost of \$2,601,866.

### **Maintenance**

Amount expended for highway maintenance for three-year period, December, 1919, to November 30, 1921: Graded roads, \$1,080,849; hard surfacing, \$126,226; total, \$1,207,075.

### **State Highway Officials**

N. C. Poulson, chairman, State road commission; members, Geo. D. Casto and Ira R. Browning; H. C. Means, State road engineer.

Revised by H. C. Means, Salt Lake City.

## **VERMONT**

### **State Highway Legislation**

The administration of the highway laws of the State is in the hands of the State highway board, consisting of the governor, who is chairman ex-officio, and two other members, all of whom must be resident citizens of Vermont, one member being appointed by the governor during each biennial session of the general assembly and holding his office for four years.

The first duty of the State highway board is to appoint a commissioner of highways who shall also be a resident citizen of Vermont. The commissioner of highways is the chief executive officer of the board and its secretary, and through him the board controls and directs the use and expenditure of all State funds available for highway maintenance and improvement, appoints district highway commissioners to assist in the local administration of the law and employs such clerical and expert assistance as may be required.



Some years ago, the total road mileage of the State, which is in excess of 15,000 miles, was divided by the selectmen and road commissioners of the towns with the approval of the State highway commissioner into what is known as selected or State roads and town roads. The selected road mileage is about 4,300. It comprises the trunk lines going north and south and east and west, across the State, and also those roads which are of the greatest local importance. Other roads are known as town roads. All Federal aid money and all State money, with the exception of \$150,000.00 per annum, which goes to town roads, is expended on the State roads.

By an agreement between the State highway board and the selectmen and road commissioners of a town, or the trustees of a village, any portion or all of the State roads within the limits of a town or incorporated village, may be placed in the care of a patrolman, the town or village paying annually out of its road money toward the expense of the patrol work what seems to the State highway board a reasonable amount and the State then employs the patrolman to do the work, and pays from the maintenance fund whatever balance is necessary to prosecute the work.

There is a State appropriation of \$50,000 annually available to towns for the purpose of building or rebuilding bridges on State roads. The State highway board through the commissioner of highways may grant aid to a town from this fund to an amount not in excess of one-third of the actual cost of building or rebuilding the bridge and not in excess of \$2,500 on any one bridge. In addition to this, engineering assistance may also be granted to towns in repairing, building or rebuilding bridges on State roads, the cost of such assistance being paid from the bridge fund.

The general assembly at its 1921 session appropriated \$400,000.00 to match Federal aid in highway construction and passed other legislation creating a machinery fund making it possible for the State to accept and care for surplus war material allotted to the State by the Federal government for use in road building. The surplus war material received to date together with the storage plant which has been built containing a well equipped repair shop approximates one-half million dollars in value.

### Local Legislation

Towns (townships) may at their annual meeting elect one or two road commissioners to have charge of the road work in the town for the ensuing year, or if the town so votes, the commissioners may be appointed by the board of selectmen.

### Bond Legislation

It has been the policy of the State to enter into only such road improvement as could be paid for with the funds available from taxation, and up to the present time no bond issues have been made for State road work. There is, however, on the statute books a law which allows any town or incorporated village or city to issue bonds to an amount not exceeding three times its grand list—1 per cent of the assessed valuation—for the purpose of purchasing road-making apparatus and building permanent highways.

### Automobile Registration

Automobiles are registered with the Secretary of State. The fees are: passenger cars, \$1 per horsepower for first year, 75 cents per horsepower for second year, and 50 cents per horsepower for all subsequent years; motor trucks, trailers and traction engines, carrying capacity of 1,500 lbs. and not exceeding one ton, \$20.00; exceeding 1 ton and not over 1½ tons, \$30.00; exceeding 1½ tons and not over 2 tons, \$40.00; exceeding 2 tons and not over 2½ tons, \$50.00; exceeding 2½ tons and not over 3 tons, \$75.00; exceeding 3 tons and not over 4 tons, \$100.00; for each additional ton or fraction of a ton above four tons, \$25.00; municipal owned trucks, \$10.00; motor cycles, annual flat rate fee of \$7.50. Operator's license, \$2.00; chauffeur's license, \$3.00. On and after August 1st one-half the above rates is required. Examination fee of \$2.00 is required with first operator's or chauffeur's licenses. Dealer's license, annual fee, \$50.00.

### Road Funds

A State tax of 5 per cent. on each dollar on the grand list of the State ( $\frac{1}{2}$  mill on the dollar) is annually levied. The proceeds from this tax are divided among the towns, cities and villages according to their road mileage. The amount raised by this tax in 1921 was \$140,220. The present law appropriates annually \$260,000.00, which is known as the State-aid fund. Out of this is deducted a part of the expense of administering the law, and any town or city which votes prior to April 1, from \$100 to \$500 for State road work, can have the amount voted, doubled by the State out of this fund.

After paying the expense of collecting the automobile registration and license fees, and furnishing number plates, the balance is paid into the State treasury and placed to the credit of the highway maintenance fund, all of which is used, with the exception of \$150,000, in maintaining and improving what is known as the selected or State roads. The \$150,000 is devoted to the improvement of the town roads and is divided among the towns



of the State according to their unselected road mileage. It is estimated that the income from the registration and license fees this year will be \$650,000.

### State Highway Officials

State highway board, Governor James Hartness, chairman ex-officio, Springfield; W. N. Bryant, Ludlow; S. B. Bates, Derby.

Commissioner of highways, T. W. Dix, Montpelier; deputy commissioner of highways, C. M. Brooks, Montpelier; chief clerk, W. L. Carpenter, Montpelier; assistant in charge of State garage and machinery, R. S. Currier, Barre; clerk in charge of patrol accounts, A. H. Gates, Franklin.

State engineer, H. M. McIntosh; assistant State engineer, G. A. Reed.

Revised by W. L. Carpenter, chief clerk.

## VIRGINIA

### State Highway Legislation

A State highway commission consisting of five members is appointed by the governor, with the consent of the Senate. The members of the commission are appointed for terms of six years, the terms of not more than two to expire in any one year. The governor appoints a State highway commissioner for a term of six years.

The State highway commissioner has power to locate and establish the roads comprising the State highway system between points named in the act of legislature creating such a system. This system embraces 28 routes and includes about 3,740 miles. Local road authorities, or 50 or more citizens may within 30 days, appeal from the rulings of the State highway commission relative to the locations, to the commission as a body. The commission may hear evidence and argument as to desired changes in the locations and decide as to whether any changes shall be made. Should no appeal be made within 30 days from the date on which the State highway commission has filed report of the location of any State highway with the clerk of the county, or the clerks of several counties, through which the road is located, the location as made by the State highway commissioner stands.

The State highway commissioner also has the power, subject to the approval of the commission, to apportion to the various road projects in the State highway system, the available State and Federal funds for each calendar year, the approval shall not be given until after a public hearing has been had at which the various sections of the State may, through interested citizens, express a desire for modifications or changes in the appropriations.

The commission may acquire rights of way under the power of eminent domain. It has also the power to fix the salaries of all assistants and employees who are selected by the State highway commissioner and subject to removal by him. It is given power to make and enforce rules and regulations governing traffic on all State highways and duly authorized employees of the commission have police power in the enforcement of them.

Each section of the State highway system improved under the commission is maintained by and at the expense of the State. Federal aid is applied to projects in the State highway system exclusively.

In addition to the State highway system provision is made for State aid to the several counties which is apportioned in proportion to the State taxes paid in from each, and which must be met by at least an equal amount of local funds. State aid may be applied to either new construction or to the maintenance of roads already improved. All State-aid work is carried on by the several counties, but must be approved and accepted by the State highway commissioner before the State portion of the cost is paid over to the county. The counties make the selection of State-aid projects, but plans and specifications for them must be approved by the State highway commissioner before the work can be undertaken.

#### **Local Road Legislation**

Jurisdiction over county and district roads is vested in county boards of supervisors, one from each district. Each board is authorized to appoint a county road superintendent or a road superintendent for each district or group of districts, or it may appoint both county and district superintendents.

#### **Bond Legislation**

By a vote of the people in November, 1920, the State constitution was so amended as to provide that the legislature might issue bonds in such amounts as it might consider expedient. The proceeds from these bonds are to be used for the construction of a State system of highways. Unless a special session of the legislature is called the law carrying the referendum measure into effect will not be acted upon until the regular session in 1922.

Upon the petition of a majority of the board of supervisors of any county or upon the petition of 150 freeholders of a county, the circuit court may, upon the certification of the State highway commissioner that the proposed amount of money and type of construction are adequate, order an election to be held to determine whether bonds shall be issued. The amount of outstanding bonds cannot exceed 10 per cent. of the total taxable values of the county or district. The bonds cannot be for a period greater



than 34 years and the interest rate must not be greater than 6 per cent. The board of supervisors must make an annual levy sufficient to meet the interest on bonds and create a sinking fund which will retire the bonds within the time specified, also required to make a levy sufficient to create a maintenance fund equal to 3 per cent. of the total bond issue, for the upkeep of the roads when completed. All work done with funds derived from county or district bonds must be under an engineer approved by the State highway commissioner.

### **Convict Labor Laws**

All male prisoners, both felony and misdemeanor, with the exception of such as may be considered dangerous or desperate, are employed on the State convict road force. Practically the entire force is employed on the construction and maintenance of the State highway system.

### **Automobile Registration**

The law provides for annual registration with the secretary of the commonwealth. The fee for registration, license and tags is 60 cents per horsepower. One-half of this is charged after September 1 of each year. Two-thirds of the fund thus created is applied to the maintenance of the State highway system, and the balance is applied toward meeting the Federal aid.

### **Highway Funds**

Funds for the construction of roads included in the State highway system are derived from a direct legislative appropriation, a special levy of 1 mill on the dollar, and one-third of the automobile license tax, together with the labor of the State convict road force. Any part or all of these resources may be issued to meet the Federal aid.

Funds for State aid are derived from a direct legislative appropriation which, as already stated, must be met by an equal amount of county or district funds. The State aid appropriation may be applied to either new construction or to the maintenance of improved roads included in the county system.

Two-thirds of the automobile license tax is used for the maintenance of roads included in the State highway system and any part of the labor of the State convict road force which the State highway commissioner may consider necessary may be used for that purpose.

For the current fiscal year, October 1, 1921, to October 1, 1922, the State highway work will be financed with State funds as follows:

Receipts from special 1-mill State-wide tax.....\$1,700,000  
 Receipts from automobile fund for construction... 700,000  
 Receipts from automobile fund for maintenance... 1,400,000

Total.....\$3,800,000  
 Value of prison labor to be performed about..... 400,000

Total of State funds, including the value of  
 prison labor.....\$4,200,000  
 and appropriations to be made by the General Assembly which  
 meets January 10, 1922.

MILEAGE AND COST FOR TWO YEARS ENDING SEPTEMBER 30 1921

	Cost including Supervision	Total	Mileage	Total
Construction and Re- construction State Highways.....	\$7,564,872.62		610.57	
Construction and Re- construction State Aid Roads.....	2,947,563.28	\$10,512,435.90	622.21	1232.78
Maintenance State Highways.....	\$2,134,750.98		1985	
Maintenance State Aid Roads.....	762,151.38	\$2,896,902.36	1927	3912

State Highway Officials

State highway commission: Wade H. Massie, chairman; J. A. Bear, member; H. P. Beck, secretary; Horace Hardaway, member; Frank W. Davis, member. G. P. Coleman, State highway commissioner; Wm. F. Cocke, assistant commissioner; Dudley McDonald, second assistant commissioner; M. P. Berkeley, secretary; B. Atkins, chief clerk; C. S. Mullen, engineer of construction and maintenance; F. D. Henley, engineer of State aid; J. J. Forrer, assistant engineer; A. H. Pettigrew, assistant engineer State aid; Wm. R. Glidden, bridge engineer; Harrison, engineer of plans and estimates.

Revised by G. P. Adamins, Richmond, Va.



## WASHINGTON

### State Highway Legislation

The construction and maintenance of State roads is under the direction of the State supervisors of highways, who is appointed by the director of public works. The State highway committee, which consists of the governor of the State, the State auditor, and the State treasurer, ex-officio, with the supervisor of highways as secretary of the committee, apportions the amounts appropriated by the legislature to the various counties, awards contracts and decides matters of general policy in connection with the work of the State highway department.

The total length of all highways in the State is 42,428 miles. Of this total mileage, the State system consists of 5,829 miles, established by the legislature as primary and secondary highways.

The primary State highways (2,660 miles) are built and maintained by the State from appropriations made by the legislature from the primary highway maintenance fund. The secondary State highways (3,169 miles) are built by the State and maintained by the counties.

### Local Road Laws

The roads of the county, not under the township system, are in charge of the board of county commissioners. The board divides the county into districts and appoints a supervisor for each. A county engineer is elected biennially. Two counties have adopted the township system, and their roads (except State and county main roads) are under the commissioners or supervisors of each township.

### Local Bond Legislation

There are in Washington three operative statutes passed and effective in the years 1890, 1893 and 1913, respectively. The last two are very similar, and the act of 1913 is intended to confer additional power and authority. Bonds may be issued under the provisions of either of these statutes. For details regarding these laws see pages 225 and 226, Highways Green Book, 1921 edition.

### Automobile Registration

Application for a motor vehicle license is made to the county auditor and is forwarded to the director of licenses, who issues a license and number plates. Annual license fees are as follows:

Automobiles for private use weighing less than 1,500 pounds \$10, plus 60c. for each 100 pounds in excess of this weight. Automobiles for hire, the rate is \$20 for 1,500 pounds plus 60c. for each 100 pounds in excess thereof and \$3 per person of rated carrying capacity. For auto stages, the rate is \$25 for

1,500 pounds plus \$3 for each person at rated carrying capacity; 1,500 pounds and over \$25 plus 60c. for each 100 pounds of weight and \$3 per person based on rated carrying capacity. For auto stage trailers the rate is \$10 for 1,500 pounds plus \$3 per person, but if the weight is over 1,500 pounds, 60c. for each 100 pounds of weight is added.

For motor trucks the rate is \$10 for 1,500 pounds plus 40c. per 100 pounds of weight for all in excess of 1,500 pounds and in addition 40c. per 100 weight at the rated carrying capacity up to 6,500 pounds. For trucks weighing more than 6,500 pounds the rate is \$10 plus 60c. per 100 pounds of weight and in addition 50c. per 100 pounds of weight at rated carrying capacity.

Motor cycles \$6; dealers in motor cycles, \$10; dealers in motor vehicles \$50. Additional dealer's license plates bearing same number \$10; duplicate license certificates \$1; dealer's duplicate plates \$5 each; transfer motor vehicle license \$1.

### Road Funds

There is annually levied a State-wide tax of 1 mill from which the legislature appropriates the funds needed for the construction of designated portions of State highways and for the support of the State highway department. This tax yields about \$1,200,000 annually.

The gross receipts from motor vehicle registration amounted to \$2,925,730 during 1921. About \$1,400,000 annually is appropriated from this fund by the legislature to the counties for the maintenance of "primary highways," the balance being appropriated for construction of State highways.

There is also annually levied a 1½-mill State-wide tax for permanent county highways which yields about \$1,800,000 annually. This money is paid into the State treasury and credited to the counties through which it was received without additional appropriation by the legislature. This fund is used by the counties for building permanent roads under plans and specifications approved by the State highway department.

### Progress Report

Work completed during 1921 under State control includes 72 miles of grading at a total cost of \$916,410; 112 miles of grading and surfacing costing \$1,792,295; 68 miles of concrete paving at a cost of \$2,962,534; and 4 bridges costing \$51,770. Work contracted for by the State in 1921, but not completed before January 1, 1922, includes 33 miles of grading at an estimated cost of \$271,162; 123 miles of grading and surfacing, estimated to cost \$1,338,790; 40 miles of concrete paving estimated at \$1,475,648; and 9 large bridges at an estimated cost of \$398,753.



The program for 1922 includes the expenditure of \$6,500,000 for construction and \$1,400,000 for maintenance. New bridges to be contracted for in 1922 includes one 125-foot clear span swing draw bridge at Raymond in Pacific County, and a 2,000-foot steel bridge over the Snake River at Central Ferry.

### State Highway Officials

Governor Louis F. Hart, chairman; C. W. Clausen, State auditor; C. L. Babcock, State treasurer; James Allen, supervisor of highways and secretary of the State highway committee; J. A. Davis, chief engineer; G. T. McCoy, office engineer; E. R. Hoffman, engineer of materials and tests; C. E. Andrew, bridge engineer; F. R. Hewett, maintenance engineer; C. L. Dufault, right-of-way agent.

Revised by James Allen, State supervisor of highways.

## WEST VIRGINIA

### State Highway Legislation

The legislature of 1919 enacted a new road law providing for a State system of roads connecting the various county seats of the State and the leading highways of adjacent States. It created a State road commission consisting of three members of well known and successful business qualifications, appointed by the governor, to hold office for two, four and six years, respectively, from June 1, 1921, not more than two of whom shall belong to the same political party.

The public roads of the State are divided into two classes, namely, State roads and county roads. State roads are those taken over by the State for construction or maintenance. All other public roads are under jurisdiction of the counties.

The State road commission has full power and authority in the construction and maintenance of all roads comprising the State road system which are constructed and maintained entirely with State funds. County roads likewise are constructed and maintained with county funds. There are no State aid roads; that is, roads improved jointly by State and county.

The State road funds are pro-rated for expenditure in the various counties according to the county's mileage of what are known as "Class A" roads, heretofore designated and established under the former law. These were main inter-county roads passing generally through county seats, commercial centers and agricultural sections, and comprised of 4,675 miles, of which about 3,400 miles have been designated as State routes under the new law. The total mileage of public roads in the State is approximately 32,000 miles.

For the purpose of administration, the 55 counties of the State are grouped into five divisions, each in charge of a division engineer, who prepares plans and supervises construction on the State roads.

The commission is authorized and empowered to acquire lands and establish stone quarries, stone crushing plants, cement and brick manufacturing plants and other plants deemed necessary in the prosecution of its work.

The law provides for a uniform road sign system for all State and county roads, which shall be devised by the commission, erected and maintained by the State and county on State and county roads respectively.

The commission is required to devise a uniform system of accounting for road moneys expended by the various counties and to see that the same are properly installed and kept.

### Local Legislation

Jurisdiction over county roads is vested in elected boards of county commissioners known as county courts, who may appoint a county road engineer or a county road supervisor who shall have charge of construction and maintenance of county roads. Such county road engineer must hold a certificate of efficiency from the State road commission to be eligible for appointment. The county courts have power to fix and lay lawful tax levies for county road and bridge improvement.

### Bond Legislation

The 1921 session of the legislature authorized the issuance and sale of \$15,000,000 of the \$50,000,000 of State road bonds authorized by popular vote in November, 1920. This money cannot be expended for other than the construction and reconstruction of State roads.

Maintenance funds are derived from the automobile license taxes after providing for (1) interest and sinking fund on the State bonds and (2) the administrative expenses of the State road commission. In the event of the automobile tax fund being insufficient for the above purposes, the legislature authorized a State levy to provide for the retirement of the bonds.

The county courts may issue county or district road bonds to the extent of 5 per cent. of the taxable valuation of the county or district as the case may be, only upon petition of voters and approval of the proposition at a general or special election of three-fifths of the votes cast.



### Convict Labor

State convicts may be employed in the construction and maintenance of the State road system. Such convicts as are not needed or required by the commission may be employed on county roads. All county prisoners who are able-bodied males over 16 years of age must work on county roads.

### Automobile Registration

Automobiles are registered and license tax collected by the State road commission, the fees being as follows: Class "A"—All motor vehicles equipped with pneumatic tires and not used for hire, 30c. per horsepower and 30c. per 100 pounds of weight of vehicle and load, the latter being the adult capacity multiplied by 125.

Class "B"—Trucks with solid tires, 1 ton or less \$25; 2 tons \$50; 3 tons \$75; 4 tons \$100; 5 tons \$150.

Class "C"—Trailers with solid tires, 1 ton \$10. For each additional ton capacity \$15. The fees for trailers equipped with pneumatic tires is one-half of above rates.

Class "D"—Passenger vehicles operated for hire, 50c. per horsepower and 50c. for 100 pounds of weight and load as determined in Class "A."

Class "E"—Motor cycles \$5; with side car \$7.50.

Class "F"—Tractors \$10 per ton up to 5 tons; 5½ tons to 11 tons \$60 to \$180. No charge is made for tractors used for agricultural purposes only provided that the owners are liable for damages done to the road surface for failing to use proper safeguards. Gross weight limit of vehicle and load 11 tons; 17,000 pounds on one axle; 9,000 pounds on one wheel; 600 pounds per inch width of tire.

The above fees are in addition to a personal property tax.

### Road Funds

For fiscal year, July 1, 1920, to July 1, 1921:

#### *Receipts.*

Balance on hand.....	\$ 933,234.00
Motor vehicle licenses.....	1,175,365.00
Refunds to State road fund.....	181,945.00
	<hr/>
	\$2,290,544.00
Received from Federal Government.....	927,472.00
	<hr/>
Total.....	\$3,218,016.00

*Disbursements.*

Federal aid disbursed.....	\$1,029,320.00
State aid disbursed. ....	392,473.00
Other disbursements. . . . .	454,225.00
Total.....	<u>\$1,876,018.00</u>

Balance on hand July 1, 1921..... \$1,341,998.00

The counties expended on Class "A" road construction and maintenance \$6,491,552, making a total expenditure by both State and counties of \$8,367,570, including State and Federal aid projects.

For 1922 there is available \$4,000,000 of the State bond issue and \$802,000 Federal aid. The automobile fund is estimated at approximately \$1,750,000. The counties had on hand July 1, \$12,817,115, and laid levies yielding approximately \$3,900,000.

The amount to be spent by the State on new construction is \$4,802,000 including Federal aid.

**Progress Report**

Following is a summary of the road work carried on under supervision of the State road commission during the year ending July 1, 1921. This does not include work done directly under county supervision:

Type	Miles	Improved Road Approximate Cost	Total To Date	Under Contract
Graded earth.....	153	2,146,000	425	189
Gravel.....	5	80,000(a)	15	24
W. B. Macadam....	2	20,000(b)	159	5
Bit. Macadam.....	13	247,000(b)	167	25
Concrete.....	32	120,000(a)	179	51
Brick.....	17	850,000(a)	184	3
Asphalt Concrete....	3	111,000(b)	49	4
Totals.....	225	4,574,000	1178	301

(a) Surfacing and Grading.

(b) Surface only. The 1922 program provides for about 125 miles of hard surfaced roads at a cost of about \$4,800,000.

The 1922 program provided for about 125 miles of hard surfaced roads at a cost of about \$4,800,000.

**Maintenance**

The State did not maintain any roads during 1921. During 1922 \$500,000 is expected to be spent for maintenance.

**State Highway Officials**

C. P. Fortney, chairman, State road commission; E. B. Stephenson, commissioner; N. P. Whitaker, commissioner; E. B. Carskadon, secretary; headquarters, Charleston.

Revised by E. St. C. Smith.



## WISCONSIN

### State Highway Legislation

The State highway commission is composed of five members, two being ex-officio members, viz., the dean of the college of engineering of the State University and the State geologist. The three other members are appointed, one every two years, by the governor for terms of six years. They serve without compensation, except actual expenses.

The State highway engineer, under whose immediate direction the road work is carried on, is appointed by the State engineer with the approval of the State highway commission.

There are two systems of roads to which the State contributes aid, viz., county systems of prospective State highways, consisting of about 20,000 miles selected by the county boards with the approval of the State highway commission for improvement with State and local funds, and State trunk highways, comprising 7,500 miles connecting county seats in important towns and selected by the State legislature. The greater portion of this State trunk highway system connects with the county systems of prospective State highways.

Prospective State highways are constructed by the county, town and State jointly, or by the county and State jointly. In the former case the town, county and State each pays one-third of the cost. In the latter case the county pays three-fifths and the State two-fifths. This applies to both road and bridge construction.

State trunk highways are constructed under the supervision of the State highway commission with funds provided by the Federal government, State and the counties. A county may assess a portion of the cost, not exceeding 40 per cent. of its share, on the towns or town benefited by the improvement. State trunk roads are maintained by the counties under the supervision of the State highway commission.

Under the statute assenting to the Federal-aid law, the State highway commission in 1917 selected a State trunk highway system of 5,000 miles, which was increased to 7,500 miles in 1919. All improvements with Federal aid must be made on this system.

The joint Federal and State fund is allotted to the counties, one-third in proportion to area, one-third in proportion to valuation, and one-third in proportion to total road mileage. The counties are required to pay one-third of the cost of construction of roads built with Federal and State funds. Federal-aid construction is performed directly by the State, generally by contract.

When the State trunk highways are maintained by the counties, in accordance with the regulations of the State highway commission, the counties are reimbursed for the cost by the State. Usu-

ally the actual work of maintenance is performed under the patrol system, the patrolmen acting under the direct instructions of the county highway commissioner.

All portions of the State highway system are marked by a standard design which is uniform on all roads of the system with the exception of the number, which varies for each route and corresponds to the number shown for that route on the State highway commission's official map. Suitable guide and warning signs have also been erected on all parts of the State system.

### **Local Legislation**

General jurisdiction over all roads in each town other than those on the county system of prospective State highways and the State trunk highway system is in the hands of the town board of supervisors, consisting of three members, all elected annually.

The county board of each county, composed of a supervisor from each town, village, and city ward, except in Milwaukee County, where there is one member from each assembly district, elects a county highway commissioner who is in charge of all construction and maintenance work except that the county committee selected by the board acts as a board of directors jointly with the State highway commission in the general control of the work in each county.

The legislature of 1919 enacted a statute providing for cash payment of all road taxes.

### **Bond Legislation**

Any county, through its board, may issue non-taxable coupon bonds bearing interest at 5 per cent., payable semi-annually and to run not to exceed 20 years, for the original improvement of any portion of the system of prospective State highways. The bonds may not be sold outside of the county until the residents of it have a reasonable opportunity to purchase them, and when sold, the proceeds must be apportioned by the county board. The form of the bonds must be approved by the State highway commission.

The bonds are to be divided as to denominations and due dates so as to have an equal amount payable each year. The interest and principal are provided for by direct tax to be assessed by the county board. Provision is also made for the issuance of bonds conditioned upon the payment of all interest by private subscriptions, but money or approved securities must be first deposited to secure the payment of this interest.

County bonds may be issued at any one session of the board in an amount not exceeding two-fifths of one per cent. of the



assessed valuation of all taxable property in the county. This may be increased by the action of subsequent county boards, but the total amount of bonds so issued or outstanding at any one time must not exceed one per cent. of the total assessed valuation of the county must be submitted to and adopted by vote of the people.

Town bonds may be issued for the original improvement of any portion of the system of prospective highways in a manner similar to that of the county, but the proposition must, without exception, be submitted to a vote of the qualified electors of the town. The issuance of these bonds is conditioned on the county issuing bonds to a like amount. Town bonds are not available for State aid.

### **Convict Labor Laws**

Convicts in county jails may be used in quarrying stone for road work. Convicts in the State prison may also be used in the construction of roads. The employment of convicts on State roads is optional with the counties.

### **Automobile Registration**

The law provides for annual registration with the Secretary of State, with the following schedule of fees: Motorcycle, \$4; passenger cars, \$10; dealers and manufacturers, for each garage, \$25; trucks, 2,100 pounds or less, \$15; 2,100 to 5,100 pounds, \$20; 5,100 pounds and over, \$25.

### **Road Funds**

One-fourth of the net registration revenue collected by the Secretary of State is returned to the county from which it is collected at the end of each year for the maintenance of the county system of prospective State highways. An amount not to exceed \$168,000 per year is then set aside from the balance as an administration fund for the State highway commission. The remainder is used for construction and maintenance of State trunk highways. This fund, exclusive of the one-fourth returned to the counties, amounts to about \$2,835,000 annually.

In addition to this there is an annual appropriation of \$785,000, to be allotted to the counties for State-aid construction. Allotments to counties are made in the ratio that the assessed valuation of each county bears to the total assessed valuation of the State.

The 1919 legislature provided that a State tax should be levied for the three years beginning July 1, 1919, which would produce \$1,700,000 a year for State aid and to meet allotments of Federal-aid. The rate necessary to produce this total will approximate four-tenths of a mill.

### Progress Report

The following is an estimate of construction and maintenance executed in 1921 and projected for 1922:

#### Construction.—

Type	1921	Cost per mile	Estimated
	Construction Mileage		Construction 1922
Concrete.....	340	\$32,500	400
Bit. Macadam.....	30	18,350	30
Plain Macadam.....	33	5,750	30
Gravel.....	1,477	4,130	1,200
Misc. Surfacing.....	348	3,500	250
Graded and drained only....	1,378	2,060	1,000
CONSTRUCTION			

*Maintenance.*—In 1921, 7,260 miles of the 7,500 miles of State trunk highway system were maintained by patrol and gang maintenance. It is expected that this will be increased to 7,400 miles in 1922.

During 1921 the counties maintained approximately 7,000 miles of county trunk highways, which will be increased to approximately 8,000 miles in 1922.

These county trunk highways are all marked with letters to distinguish them from the State trunk highways.

*Expenditures.*—Local.—It is estimated that in 1921 the counties provided the sum of \$6,231,324 for county aid roads and bridge construction. The expected expenditure for 1922 is \$2,071,678. The maintenance expenditures by the counties for 1921 amounted to \$1,838,875, and for 1922, \$2,241,307.

The expenditures for Federal-aid construction including bond issue work under supervision of the State highway commission for 1921 were \$8,475,728 and for 1922 are \$13,784,142.

The maintenance of State trunk highway system for 1921 amounted to \$2,229,185 and for 1922 it is estimated that \$2,262,816 will be expended.

### State Highway Officials

Wisconsin highway commission, Madison: J. A. Hazelwood, chairman, Jefferson; W. O. Hotchkiss, State geologist, Madison (ex-officio); F. E. Turneure, Madison (ex-officio); Al. C. Anderson, Menomonie; Fred Pabst, Oconomowoc.

A R. Hirst, State highway engineer; M. W. Torkelson, assistant engineer; H. J. Kuelling, construction engineer; T. J. Donoghey, maintenance engineer; C. W. Thompson, chief clerk.

Revised by M. W. Torkelson, assistant engineer.



## WYOMING

### State Highway Legislation

The State highway department consists of a State highway commission of five members, and a State highway superintendent. Commissioners are appointed by the governor for terms of six years, the terms of two commissioners expiring biennially. The commissioners receive a salary of \$600 per year each and actual expenses. The State highway superintendent, who must be experienced and skilled in highway and bridge construction and maintenance, is appointed by the commission for an unlimited term. His salary is fixed by the commission.

The commission is authorized to designate, construct, and maintain at the expense of the State, a system of State highways, and has to date taken over approximately 1,600 miles. Federal-aid funds may be applied by the commission to this system. The State has 40,000 miles of public roads.

The commission is authorized to co-operate with counties and the Federal government in the construction of roads within, or partly within National forests. The highway department also co-operates with counties in the construction and maintenance of county roads not included in the State system, furnishing plans, specifications, etc. The State and the county each pay 50 per cent. of the county roads' cost of construction, the county paying the entire cost of maintenance. Plans and specifications for all bridges in the State constructed by counties or cities costing \$1,000 or more are prepared by the State highway superintendent, whose approval must be secured before any payments can be made on their construction.

### Local Road Legislation

The county commissioners have charge of all county roads. Each county is divided into road districts and a supervisor is elected for each district who is under the direction of the county commissioners. The county road and bridge funds are obtained from a tax at a rate of not to exceed 3 mills on the dollar on all taxable property in the county, 2 \$2 poll tax and 25 per cent. of the revenues collected by the United States Forest Service, which is distributed among the counties in which the reserves are located.

### Bond Legislation

Practically all of the \$2,800,000 voted in 1919 has been expended. An additional \$1,800,000 was voted in 1921.

### **Convict Labor Laws**

Any convict may be put to work on roads and streets. To date convicts have been used only on jobs where it is difficult to place the work under contract.

### **Automobile Registration**

Motor vehicles are registered with the Secretary of State on the basis of 40 cents per h. p., for passenger cars; 75 cents for each 100 pounds, or major fraction thereof on trucks and trailers; and \$5 on each bicycle or motorcycle. Dealers license fees amount to \$50 per annum. These fees are credited to the State sinking fund for the purpose of paying the principal of State highway bond issues, the amount collected in 1921 being \$287,304.28.

### **Road Funds**

During 1921 the State highway department expended approximately \$2,200,000 derived from the State bond issue and from Federal aid. There is still under contract and proposed an additional \$2,500,000 worth of work which will be completed during 1922. There is also a legislative appropriation of \$200,000 available for expenditure during 1922 and \$1,000,000 from a State bond issue.

### **Progress Report**

During 1921 there was constructed and reconstructed a little more than 700 miles of new highway. There was also improved with maintenance about 1,800 miles.

### **State Highway Officials**

Commission: M. R. Johnson, Wheatland, Wyo.; Joe C. Kinney, Cokeville, Wyo.; S. W. Conwell, Casper, Wyo.; J. H. Snyder, Lovell, Wyo.; L. R. A. Condit, Barnum, Wyo.; L. E. Laird, State highway superintendent; Z. E. Sevison, State highway engineer.

Revised by Z. E. Sevison.



## HIGHWAY ADMINISTRATION AND PROGRESS IN CANADA

*Revised by W. A. McLEAN,*

*Deputy Minister, Department of Public Highways, Toronto,  
Ontario, Canada.*

IN essential particulars the various Canadian governmental agencies have almost exact parallels in the United States. The Dominion or Federal Government corresponds to the Government of the United States. The provincial governments, of which there are nine, correspond to those of the States. The Provinces in turn are divided into counties which differ from those in the United States only in the detail that all cities and certain towns are not included under the jurisdiction of the county government. The townships into which the counties are divided are similar to the corresponding units in the States.

The formation of a provincial government in its bearing on the management of a department has distinctive features. Following a general election, the representatives of the Crown send for the leader of the successful party and request him to form a government. The party leader then selects from his elected followers a number of ministers, each of whom assumes responsibility for the management of a department. These ministers compose the council or cabinet, have seats in Parliament, receive a salary, and compose a group giving their full time to matters of provincial government. Officials of the Government are appointed by the Cabinet on recommendation of the minister having charge of the department for which the officer is appointed. In general, such appointments are of a permanent nature, and are rarely terminated with a change of government.

Governments differ as to number of ministers and grouping of departments, but commonly include ministers of Education, Agriculture, Public Works, Public Highways, as well as an Attorney General, a Provincial Secretary and a Provincial Treasurer. Each department may include various branches with an officer in charge of each. But the chief officer of each department is the Deputy Minister, who has general supervision of all branches.

### **Highway Administration—National, Provincial and Local**

*National.*—As in the United States, the Federal or Dominion Government exercises no direct control over the construction and

maintenance of highways, but in July, 1919, the Governor General assented to an act of Parliament known as the Canada Highways Act which provides that the Dominion Government may aid the Provinces in the construction and improvement of highways. Twenty million dollars was appropriated, to be expended during a period of five years from April 1, 1919. The money is allotted to the Provinces in two ways, (1) \$80,000 is to be paid to the government of each Province, (2) the remainder is allotted in proportion to population. The amount to be apportioned to particular highways is 40 per cent of the cost.

The rules and regulations established by the government provide that the highways to be aided must be main or market roads included in a five-year program of construction which must previously have been approved. The highways must be built in accordance with plans and specifications approved by the Minister of Railways and Canals who is charged with the administration of the act; but the onus of supervision is placed upon the provincial highway department, which must also agree to maintain the roads constructed.

The methods of government control, and the general nature of the subsidy arrangement, are similar to those which exist in the United States under the Federal Aid Act. The number of provincial units is only 9 instead of 48, and the 9 Provinces deal directly with the Dominion authorities at Ottawa.

The plan represented as great a departure from prevailing methods of highway administration as did the Federal aid plan in the United States; and the first year of operation has been devoted largely to the development of methods of coöperation. In this respect also the Canadian operations are following very closely the development of Federal aid in the United States. The organization and methods of procedure have by this time reached a workable stage, however, and it is expected that this year's work will show substantial completion of actual construction.

Up to June 1, eight of the nine Provinces had submitted program maps of the selected systems of highways. The total length of designated Federal aid roads was about 18,000 miles, and the sum of \$73,000,000 was being raised by the several Provinces to be applied on this system during the next five years.

*Provincial.*—The extent of highway control exercised by the provincial governments is of two orders. In one group, which includes the Provinces of Prince Edward Island, Nova Scotia, New Brunswick, and British Columbia all roads are under the control of the central provincial government, both as to construction and maintenance. In the other five Provinces of Ontario, Quebec, Manitoba, Saskatchewan, and Alberta the counties or townships share in the control of certain highways to varying degrees.



*Administration in British Columbia.*—Taking British Columbia as a type of the Provinces which exercise complete control, the entire road system outside of municipalities is administered by the provincial department of public works; at the head of which is the minister of public works, who is also a member of Parliament. Under the minister is a deputy minister who is a permanent official, not subject to removal with changes of administration. The roads branch of the public works department is controlled directly by a public works engineer and his staff consisting of an assistant public works engineer, an office engineer and a designing engineer, together with eight district engineers and their assistants, one in each of the eight districts into which the Province is divided.

Annual estimates of the funds required for anticipated work in each district are prepared by the district engineer and submitted to the public works engineer. After inspection and possible revision they are submitted to the Provincial Legislative Assembly for inclusion in the budget. The completed budget assigns to each district a certain amount, which is apportioned to various works by the district engineer subject to the approval of the public works engineer. The work is carried out under the direction of the district engineer, who is responsible, and accountable for all expenditures. All accounts are vouchered and approved by the district engineer or his assistant and paid by a government agent. Copies of vouchers are forwarded to the public works engineer for approval, thence to the deputy minister of public works for the same purpose, then to the audit department, and finally to the treasury department, where the expenditures by the government agent must be approved. In some of the districts most of the road work is done by day labor, but in general new work is usually undertaken by contract. There is no "statute labor."

*Administration in Ontario.*—One of the second group of Provinces, in which road control is not entirely in the hands of provincial officials, is Ontario. The units of government sharing in road control in this Province are the Province, the county and the township.

Road construction and repair was originally a local government function. The roads of least importance, generally those of purely township significance, are in this Province, maintained and constructed by the townships from township rates, and accounted for solely by the township council, the Province contributing 20 per cent of the cost of construction and maintenance and exercises supervision of the work in the same manner as in the case of counties.

As in the United States, very little progress was made in road improvement while it was in the hands of local authorities. The first steps toward real progress were made in 1901, when the passage of the Highway Improvement Act provided for the extension of provincial aid to the counties.

*County roads.*—The condition introduced by this act was very similar to the systems of State aid in the United States. Briefly, the act authorizes county councils to assume systems of roads to be known as county roads, which, upon approval by the provincial authority, may receive provincial aid in construction and maintenance. The county system must be adopted by by-law passed by a two-thirds majority of the county council representing at least one-half of the total equalized assessment of the county. When roads are assumed by the county in this manner the township councils cease to have control over them, nor should they make any expenditure on them. The county council is thereafter responsible for construction and maintenance. A county road superintendent, appointed by county by-law and approved by the Provincial Highway Department, is placed in actual charge of road work, but all plans, specifications, and accounts must be approved by the department of public highways before the provincial grant is made. To roads selected and constructed in this manner the Province grants 40 per cent of the expenditure on construction and maintenance.

A city may coöperate with the county council in improving the leading county roads adjacent to the city, and thereby obtain a more substantial type of construction for such suburban roads. In such a case the contribution of the Province remains 40 per cent for construction and maintenance, but the county and city divide the balance of the cost in each case between them.

*County Provincial roads.*—Certain county roads of more than local importance, which carry a considerable portion of through traffic, but which are not of sufficient importance to be classed as provincial highways, are classified as provincial county roads. Such roads continue under county control, but because of the through traffic they receive an increased provincial subsidy. In general, they form branches of the "provincial highway system," joining cities and other important terminal points of traffic. To roads of this character the Province grants 60 per cent of the cost of construction and maintenance. Cities and counties each pay 20 per cent of the cost of county provincial suburban roads.

*Provincial highways.*—In addition to the roads of the classes described above, a system of provincial highways was authorized in 1917, with a view to bringing the construction and maintenance of the principal highways of the Province under the immediate control of the provincial highways department. The department, with the approval of the lieutenant-governor in council, is authorized to take over any public highway on behalf of the Crown. The department, thereafter, is responsible for the proper construction and maintenance of the highways assumed. Adjacent to cities the costs of such highways are borne in the proportion of 60 per cent by the Province, 20 per cent by the city, and 20 per



cent by the county through which the road passes; outside suburban areas, the Province pays 80 per cent and the county 20 per cent. Provincial control is vested in the department of public highways, with a minister, deputy minister, chief engineer, three division engineers, and 25 resident engineers in charge of the sections of road, who employ foremen and day labor gangs. Much work is carried on by contract under the authority of the minister of public highways.

### Sources of Revenue and Expenditures

*The Dominion.*—The \$20,000,000 available for Federal aid is derived from the Federal treasury by appropriation made in the Canada Highways Act passed in July 1919. Expenditures from this appropriation are to be made over a period of five years and are to take the form of grants to the several Provinces upon condition that they shall expend at least half again as much as the Dominion grant. The allotment of the Dominion funds to the several Provinces made in the manner described elsewhere in this article is substantially as shown in the following table. The minimum amount which the Provinces must contribute in order to receive the Federal money is shown in the third column:

<i>Province</i>	<i>Federal grant</i>	<i>Required of Province</i>
Alberta .....	\$1,477,810	\$2,216,715
British Columbia .....	1,251,955	1,877,932
Manitoba .....	1,602,265	2,403,397
New Brunswick .....	1,168,845	1,745,767
Nova Scotia .....	1,468,720	2,203,080
Ontario .....	5,877,275	8,815,912
Quebec .....	4,748,420	7,122,630
Prince Edward Island .....	603,455	905,182
Saskatchewan .....	1,806,255	2,709,382

The grants are made through the department of railways and canals. Regulations governing the expenditures have been drawn up by the highway commissioner.

*The Provinces.*—In respect to the methods of raising revenue there is no uniformity among the Provinces of Canada. In this they resemble States. Perhaps the nearest approach to a generalization that can be made is that none of them employ that method which is so common in the United States—the taxation of abutting property. Rarely in Canada is such a tax levied, though in Ontario land adjacent to an improved road is supposed to be assessed higher by virtue of the improvement.

Nor have the automobile revenues been devoted to road construction to any degree corresponding to the practical unanimity among the States. Provincial road revenues are provided by appropriation by the legislature from the consolidated revenue funds,

which are made up in part of the motor-vehicle revenues, but the latter are not definitely set aside for road purposes except in the case of Ontario. The principle of applying them to road maintenance as distinguished from construction is not recognized.

In British Columbia and Prince Edward Island, two of the group of four Provinces in which road authority is solely a function of the provincial government, road revenues are collectible only by the Province. In British Columbia there is, in fact, no special levy for road improvement, funds for construction and maintenance being derived by appropriation from the general revenues of the Province. In this Province an act of the legislature in March, 1919, provided for a loan of \$3,500,000 for road purposes, of which it is stipulated no more than \$1,500,000 is to be expended in any one year.

Prince Edward Island levies a special road poll tax, but derives the larger part of its highway revenues from the taxes on motor vehicles and stock.

In Nova Scotia and New Brunswick, the other two Provinces of this group, taxes for road improvement are levied upon the towns and counties, though they have no control over the expenditure of the money raised. In Nova Scotia, for example, each town is taxed for highway purposes one-tenth of 1 per cent on all property assessed for taxation. Each county pays a tax of not less than 40 cents on each \$100 of taxable property, and in addition each male between the ages of 21 and 60 pays a poll tax for highway purposes. Both the towns and the counties turn the amounts received over to the provincial treasurer who in turn remits them to the provincial highways board. The law requires, however, that taxes collected in this manner must be spent in the county in which they are raised. In addition to the money derived from the county and town taxes, the provincial government appropriates annually from the general provincial funds a sum of money which may be expended for road purposes in the Province at large.

In the remaining Provinces funds are raised for highway purposes by the towns and counties as well as by the Provinces, and the moneys collected are expended by the unit of government which collects them.

Ontario's provincial expenditures are made from appropriations from the consolidated revenues of the Province. The appropriations, while based on the automobile revenues, are not confined to them and are much greater than the revenue derived from this source. The local revenues are derived from county taxes and bond issues, and from township taxes, which by by-law of the township councils may include commuted statute labor.

In Manitoba provincial revenues for construction are derived from the sale of debentures. The consolidated revenues and gen-



eral road tax funds are usable for maintenance only. Local road construction under the control of the municipal councils may be financed in three ways, either from the current revenues of the municipality (town), or from a special tax for road construction, which can be no larger than 5 mills on the assessed valuation, or by the sale of bonds. In case it is decided to resort to a bond issue, the amount to be raised must conform to the engineer's estimate, the issue must be assented to by the taxpayers, and the amount of the issue is limited to 10 per cent of the assessed valuation.

Provincial funds for road purposes in Saskatchewan are in two accounts, known, respectively, as the revenue account and the capital account. The revenue account consists of money derived from the general revenues of the Province and is usable for surveying, construction, and maintenance of roads and for the construction and maintenance of small timber bridges. Funds for the capital account are derived from the sale of bonds, and may be devoted to the construction of permanent roads and bridges of steel or concrete. Local funds in Saskatchewan are obtained by taxation of municipal property.

One of the most interesting methods of financing road improvement is that which obtains in Quebec. The provincial government was authorized in 1912 to borrow \$20,000,000 for road purposes. This money is being used to assist the municipalities in two ways. One way is by the extension of a grant covering 50 per cent of the cost of the coöperative roads built, up to a certain amount fixed by the minister of roads. The second and more interesting method permits the municipality to borrow the whole cost of the improvement from the Province, paying for the loan at 3 per cent interest for 41 years, the government contributing the principal. Obviously, the annual cost to the provincial government under this method of delayed payment is slightly less than  $2\frac{1}{2}$  per cent of the initial cost of the improvement, while the municipality pays 3 per cent of the cost each year. It is reported that the plan is working out in a highly satisfactory way. The assistance of the government has stimulated municipal enterprise, and a splendid reform, now well under way, is the result.

### Mileage and Character of Roads

There are approximately 250,000 miles of road in the Dominion of Canada, which is about one-tenth of the mileage in the United States. Definite information is difficult to obtain as some of the prairie Provinces compute the entire mileage of roads laid out on a black system of survey, while other Provinces report only the roads graded and in actual use. Reports from the various consuls and other sources indicate that the total mileage is slightly in ex-

cess of the foregoing figure, the reported mileages by Provinces being as shown in the following table:

<i>Province</i>	<i>Mileage of road</i>
Alberta . . . . .	30,000
British Columbia . . . . .	14,600
Manitoba . . . . .	68,000
New Brunswick . . . . .	15,000
Nova Scotia . . . . .	18,000
Ontario . . . . .	62,000
Prince Edward Island . . . . .	3,800
Quebec . . . . .	40,000
Saskatchewan . . . . .	30,000
Total . . . . .	281,400

### Highway Administration and Road Conditions in Canada

About 36,500 miles of the entire system are surfaced with some material, varying from sand-clay to concrete and bituminous concrete, but only about 10,000 miles are included in what may be called roads of the first class—that is, heavily traveled main thoroughfares. Much of the greater mileage of surfaced roads of all classes is in the Province of Ontario.

Roads surfaced with concrete and bituminous materials are confined almost entirely to the Provinces of British Columbia, Quebec, and Ontario. Prince Edward Island and Alberta have no surfaced roads at all. Manitoba, Saskatchewan, and New Brunswick have very little surfaced mileage, and such as they have is almost entirely gravel or sand-clay. These Provinces constitute a sparsely settled region in which the traffic has not yet become heavy enough to warrant the surfacing of roads. There are thousands of miles of trails in these Provinces, however, which are not included in the mileage of roads reported.

Methods and standards of construction for the various types of roads are practically identical with those prevailing in the United States, as are the costs of construction and maintenance.

### Traffic and Road Conditions

In 1921 there were in the entire Dominion of Canada approximately 460,000 motor vehicles. The numbers of motor trucks, automobiles, and motorcycles were not reported separately, and no estimate of the numbers of each in the Dominion can be given.

However, nearly one-half of the total number were registered in Ontario, in which the number of the several classes of vehicles were passenger automobiles, 181,978; motor trucks, 19,554; and motorcycles, 4,989. It was found that approximately 36 per cent of all motor vehicles registered were in the hands of farmers. The same year it was reported that there was one car for each 14 of the population in Ontario and one for each 12 persons in Sas-



katchewan. These figures compare very closely with the figures expressing the same relation for the same year in the States of New York and Montana, which border upon the two Canadian Provinces. New York had one car for each 13 persons and in Montana the ratio is one to ten.

The Ontario reports for 1921 show that 1 per cent of all motor trucks registered were classed as having a capacity of 1 ton or less, over 97 per cent were  $3\frac{1}{2}$  tons or less, and less than 3 per cent were of 4 tons' capacity and upward. In 1921 there were in the Province only 23 trucks capable of carrying 6 tons or more of load.

Except in Ontario and Quebec, and in parts of British Columbia motor traffic has not yet grown to proportions which justify extensive construction of the higher types of roads. Conditions in these Provinces or, at any rate, in parts of them are very similar to the traffic conditions in the border States of the United States. Parts of them are still in an undeveloped state, and very large parts of the other Provinces are still very sparsely settled. In the whole Province of Prince Edward Island in 1918 there were only 35 motor trucks. Still this country is developing with great rapidity, and Canadian road builders are attempting to make their work safe for the foreseen future. In this they are fortunate in having as a guide the experience of the United States, which has recently trod the same path.

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**PART II**  
**Construction and Maintenance of Highways**

## ROAD LOCATION

By FRANK T. SHEETS

*Illinois State Superintendent of Highways.*

THE problem of road location is one of the most important confronting highway officials today. It is perhaps the most enduring feature connected with road improvement, and if improper locations are made, great hardship will be suffered by the traveling public.

The primary factors to be considered in road location are: 1. Utility or service; 2. Safety; 3. Beauty; 4. Economy, both in first and operating costs.

In studying the problem of road location, it is essential that the class of road to be located be thoroughly kept in mind. Federal aid, State, or in other words, trunk line highways, require an altogether different treatment than secondary or township roads. The volume and nature of the traffic must be considered, and a location that may be economically sound in the case of a township, or even a county road, would prove absolutely inadequate and most costly from an operating standpoint on a trunk line highway.

In view of the enormous sums which are now being spent upon the trunk line road systems of the various States, this discussion will be limited to the location of trunk line highways, and the factors above enumerated will be considered in their relation to this class of road.

In considering the utility or service value of a road location, the nature of the traffic and the source of revenue must be given great weight. On most of our trunk line highways, the traffic is approximately 80 per cent interurban or through traffic. Only a small percentage falls under the classification of farm to market traffic. It is therefore necessary in making locations, in order that the greatest utility or service value may be assured, to consider this 80 per cent volume of traffic rather than the small percentage of farm to market traffic. It is likewise true that the construction of these trunk line highways is being financed in many States by motor license fees or by gasoline taxation. In this manner the cost is distributed over the entire State, and, as a result, the local community through which the trunk line road passes pays in most cases only a small proportion of the cost of the road through that community. In other cases, general State taxation is used to secure funds for trunk line construction; but, regard-



less of the specific method of taxation which is employed, the result is that the bulk of the funds is derived from the centers of population rather than from the small villages or rural communities. Therefore, it becomes imperative that the road be laid out to insure the minimum operating cost to the maximum number of users.

Generally speaking, this will result in direct routes between centers of population. In practically all cases, such routes have the greatest utility or service value. When one considers the cost of operating motor vehicles, which, generally speaking, is approximately 10 cents per mile, it is evident that extra miles inserted in these trunk lines results in operating costs which cannot be economically justified, and which will work a serious hardship in the general public.

Another essential in locating trunk lines is the insurance of safety to the traveling public. Short vertical curves, hair pin turns, and unnecessary grade crossings must be eliminated. And, unless a road is so located that the legal speed limit may be almost uniformly maintained without danger, the engineer is seriously at fault.

Beauty is another essential requirement in road location. The road should be located to harmonize with topographic conditions. In prairie country where straight lines are possible, short tangents with small intersecting angles zigzagging down the highway present a picture which is offensive to the eye and revolting to the aesthetic scenes of any thinking person. Where curves are put in, they should be as long as possible and should be graceful. Where there are no excuses for curves, the lines should be straight. Homely, broken-back curves, short zigzagging tangents all represent carelessness on the part of the locating engineer. Where small intersecting angles occur, a short curve might be used with safety, but it will certainly be far from beautiful. In such cases, curves not less than one thousand feet in length should be uniformly adhered to.

Generally speaking, the road which gives the minimum operating cost results at the same time in the greatest economy of construction and maintenance. However, if the construction cost necessary to insure minimum operating cost should be somewhat excessive, this should not interfere with proper location. The following specific examples show what may be done in making locations if those in charge have the courage and foresight to do so.

On State bond issue route 4 from Springfield to Joilet, which follows section lines, the mileage along existing highways totals 177 miles. The diagonal road which eliminates section lines as located by the Department of Public Works and Buildings, Division of Highways has a length of 147½ miles, representing a total saving of 29½ miles in distance between these centers of

population. At the same time, 31 grade crossings are eliminated. Taking the estimated traffic on this road alone at an operating cost of ten cents per mile, it can be conservatively estimated that this saving in length will save the people of the State about \$23,000,000 operating expense in a 20-year period.

Another example of unusual location is on State bond issue route 2 between Carbondale and Cairo where the topography was so broken as to necessitate almost complete abandonment of the existing road. As a result of the new location, the length of the route was shortened 3.7 miles, 4 grade crossings were eliminated and the grades reduced from 15 per cent maximum on the old location to a  $6\frac{1}{2}$  per cent maximum on the new.

Another example of location is on State bond issue route 10 from Springfield to Jacksonville, where the mileage along existing roads was 32.2 and along the road as located 28.8. This saved 3.4 miles and 5 grade crossings.

In summarizing the problem of road location, our transportation system may well be compared to the human body. The trunk line may be compared to the back bone or spinal column. The county roads may be compared to the ribs and limbs. The township roads which lead from farm to market, or from the farms to the county and State roads may be compared to the remainder of the body. Unless the spinal column or back bone is properly located, neither the ribs, limbs, nor remaining portions will function properly. A man with a crooked back bone is a poor specimen regardless of how fine his flesh may be. So it is with a transportation system; unless the main lines are right, the secondary lines of traffic and the farm to market roads have a very poor chance to attain maximum serviceability. Those charged with the duty of road location should realize that they are directors of a corporation of which the people are stockholders, and that this corporation is engaged in the task of building and maintaining and operating a great transportation system. Unless these directors conduct their business in such a manner as to insure the operation of this transportation system along true, economic principles, they are forcing a gross injustice on the people, and will have committed a wrong which may have no legal penalty, but which under the moral code will cause severe qualms of conscience as the results of these blunders become apparent.



## HIGHWAY DRAINAGE

By T. R. AGG

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INVESTIGATIONS that have been in progress during the past two years have developed some unexpected information relative to highway drainage and particularly with reference to the advisability of using tile drains, especially in connection with paved surfaces.

The most significant information was obtained by Clifford Older, Chief Highway Engineer of the Division of Highways of Illinois, in connection with the Bates experimental road near Springfield, Illinois. Briefly summarized, his findings were as follows:

Tile drains do not increase the supporting strength of sub-grade materials under road surfaces sufficiently to add materially to the stability of such surfaces on under-drained roads over that of under-drained roads. It was found that sufficient water reached the sub-grade through cracks in the road slab and at the edges of the slab to reduce very greatly the supporting power of the sub-grade. The use of tile under-drains did not greatly reduce the degree of saturation of the sub-grade soil. It was concluded that road slabs must be designed to support traffic loads without assistance from the sub-grade, or in other words sufficiently rigid to distribute the traffic loads over a very large area of sub-grade.

W. P. Eno, Professor of Civil Engineering, Ohio State University, has also made extensive studies of road drainage, and his conclusions correspond closely with those of Mr. Older, but a different solution is suggested. Professor Eno proposes a layer or sub-base of gravel or stone under the paved surface to add the needed stability.

These conclusions are of the highest importance to the highway engineer, because they point to the need for heavier road slabs than have heretofore been generally deemed necessary. They also indicate that little real value is obtained for the money expended for tile to be used for under-drainage along paved roads.

In the present state of knowledge of the effects obtained from tile drains along highways, the following conclusions may be drawn relative thereto:

1. Tile drains serve no useful purpose when the topography is such that effective open ditches can be provided to care for storm

water. This would apply when the minimum grades are at least one per cent and adequate cross channels exist for diverting ditch water from the highway right-of-way.

2. Tile drains are useful in lowering the general ground water level in relatively flat country and probably assist materially in furnishing a reasonably good support for low-grade surfacing, such as gravel. Such surfaces can adjust themselves to the slight settlement of the sub-grade, whereas a rigid surface cannot do so without rupture.

This condition would exist where long sections of zero grade or grades of less than  $\frac{1}{2}$  per cent are found and the water must be carried long distances in the side ditches before it can be diverted from the right-of-way of the highway.

3. Tile drains are useful for removing underground water that may be flowing along an impervious stratum not far below the road surface. Such places are often encountered and the stability of any type of road surface cannot be assured unless the water is caught in tile drains and diverted from beneath the traveled part of the road.

The degree to which drainage effects the service-ability of the road surface is a variable factor, depending upon the amount of precipitation in the locality and the manner in which it is distributed throughout the year. In the humid areas of the United States—which are, roughly, those portions east of a north-and-south line passing through Omaha and Kansas City—and the northern part of the Pacific slope, precipitation is generally in excess of 30 inches per year and distributed throughout the year, but with seasonal variations in rate. In these areas, the effect of the precipitation, both as regards its tendency to lower the stability of soils and as an eroding agent, is to be considered.

Outside of these areas the precipitation is much less and its effect as an agent of erosion is of greatest importance, although in restricted areas there may be short periods when the soil is made unstable by ground water.

The basic principle of road drainage is to minimize the effect of water to such an extent that there will always be a layer of comparatively dry soil of appreciable thickness under the travelled part of the road. This layer should probably never be less than two feet thick and for soils of a structure favorable to capillary action it should be at least three feet thick.

The investigations referred to show that no means has as yet been developed for accomplishing this. Soils can be rendered more stable by the use of tile, but not sufficiently stable to prevent dangerous distortion of a road slab unless the slab is made thick enough to spread the load over a very large area. Low-grade surfaces will be distorted, but that does not mean that they will break through, although that will happen if the traffic is heavy.



### Surface Drainage

The drainage method which is by far the most nearly general in application is that which utilizes open ditches, and the system which employs these ditches is usually referred to as surface drainage. The full possibilities of this method of minimizing the effects of storm water are rarely fully utilized in road construction. Very frequently, deterioration of a road surface is directly attributable to failure to provide adequately for the removal of the storm water and water from melting snow that has fallen on the road, or water that flows to the road from land adjacent thereto. Surface water can usually most cheaply and expeditiously be carried away in open ditches, although special conditions are occasionally encountered which require supplementary tile drains. The cross section commonly adopted for roads lends itself naturally to the construction of drainage ditches at the sides of the travelled way, and these are usually the principal dependence for the disposition of storm water.

*Run-off.*—The capacity and slope of side ditches required to insure adequate surface drainage will be affected by the amount and nature of the precipitation in the region where the road is built. The annual rainfall in a region may amount to several feet, but may be well distributed throughout the year with an absence of excessive rainfall for short periods; that is, flood conditions may rarely occur. In other areas, the annual rainfall may be comparatively small and the precipitation occur at a very high rate, or it may be at a low rate extending over a considerable period. These peculiarities must be known before an adequate drainage system can be planned.

It is almost universally true in the United States that precipitation at a high rate will be for a relatively short duration, and during these short periods, which usually do not exceed thirty minutes, a portion of the water that falls on the areas adjacent to the road and that drains to the road ditches will soak into the soil and therefore not reach the ditches along the road. The extent to which the water is taken up by the soil will vary with the porosity of the soil and the character of the growth thereon. Cultivated land will absorb nearly all of the water from showers up to fifteen or twenty minutes' duration; grass land, a somewhat smaller percentage; and hard-baked or other impervious soils will absorb a comparatively small amount. Rocky ground and steep slopes will absorb very little storm water.

The surface of the road is designed to turn water rapidly to the ditches, but when the material is the natural soil, there is always considerable absorption of storm water. Surfaces such as sand-clay, gravel and macadam do not absorb to exceed 10 per cent of the precipitation during short showers. Bituminous sur-

faces, brick and concrete pavement do not absorb an appreciable amount of storm water.

Generally it is best to assume that if a rain lasts for forty-five minutes or more, all of the water will run off, as the soil will reach a state of saturation in that time. This is not true of deep sand, but is for nearly all other soils.

The ditch capacity needed will therefore depend upon the area drained, the character of the soil, the slopes and the rainfall characteristics of the region, and upon the nature of the road surface.

The velocity of flow varies not only with the grade, but with the shape of the cross section, cleanness of the channel, the depth of water in the channel, alignment of the channel, and the kind of material in which the channel is formed. It is not necessary to go to great refinement in the design of the side ditches for the ordinary case where the water is carried along the road for only a few hundred feet. The ditches are made of ample capacity by using the commonly accepted cross section for a road, which will be discussed in a later paragraph. But where large areas must be drained by the road ditches, it is desirable to design carefully the side ditches. The bases for that design is too lengthy to be included herein.

*Ordinary Design of Ditches.*—For grades of 1 per cent or less, the bottom of the ditch should be at least  $3\frac{1}{2}$  feet lower than travelled surface of the road. The grades greater than 1 per cent this depth may be decreased one foot, and for grades of 4 per cent and upward, the depth may be still less. These general rules for depth are susceptible of variation, but are believed to be the minimum except in arid or semi-arid climates. It is far better to be too liberal in ditch allowance than to be too conservative. In arid or semi-arid regions, the ditch design will be based on the necessity of providing for flood flow and preventing damage for erosion. Ordinary drainage requirements will be satisfactory with the ditch about one foot deep.

If the topography adjacent to the road is such that it is evident considerable storm water will flow from the adjacent land to the road ditches, the design must be modified to take this into account. Sometimes such water can be diverted by ditches well back from the road, and thus prevented from flowing into the side ditches along the roadway. It is especially desirable to divert water, which would otherwise flow down the slope of a cut, by means of a ditch on the hillside above the upper edge of the slope of the cut.

Ditches are not effective unless they afford a free flow throughout their length and have an outlet to an adequate drainage channel of ample capacity. Therefore, ditch grades should be established by survey, especially if the gradient is less than 1 per cent, and the construction work should be checked to insure that the ditch is actually constructed as planned. A few high places in the



ditch will greatly reduce the effectiveness, although these may appear at the time of construction to be slight. Constricted places, such as might be due to a small amount of loose earth left in the ditch, are always to be avoided.

Where the side ditch passes from a cut to the berm alongside a fill, the ditch should be excavated throughout in the undisturbed natural soil, 5 feet or more from the toe of the slope of the fill, and along the filled portion of the road there should be a berm of 3 or 4 feet between the toe of the slope of the fill and the near edge of the ditch.

*Safety.*—The slope from the travelled part of the road to the ditch should be not greater than 3 on 1, so as to eliminate danger of overturning if a vehicle is forced to the ditch.

### Underground Water

In a preceding paragraph, mention was made of the fact that only a part of the storm water runs off over the surface of the ground, the larger part being absorbed by the soil. The water thus absorbed flows downward through the pores in the soil until it is deflected laterally by some physical characteristic of the soil structure. The movement of underground water is effected by many circumstances, but only two conditions need be discussed herein.

Underground water, like surface water, tends to attain a level surface, but in so doing it may need to flow long distances through the pores of the soil, and to overcome the resistance incident to so doing some head will be required. That is to say, the water will be higher at some places than at others. If a cut is made in grading the road, the road surface may actually be lower than the ground water level in the land adjoining the road. As a result, the water will seep out of the side slopes in the cut and keep the ditches wet, or even furnish enough water to occasion a flow in the ditch. Similarly, the higher head of the underground water near the top of a hill may result in ground water coming quite close to the surface some distance down the hill. In the past tile drains along the road have been widely used to minimize the effect of this underground water, but their efficiency in that respect is in grave doubt.

Sometimes the ground water encounters an impervious stratum as it flows downward through the soil, or one that is less pervious than the surface soil. When such is the case the water will flow along this stratum; a spring will be found at that point. This may be on a highway. Or the impervious stratum may not outcrop, but may lie only a few feet under the surface of the road, in which case the road surface will be so water-soaked as to be very unstable. This condition can be corrected by tile laid so as

to intercept the flow at a depth that precludes damage to the road. Commonly, the tile will be laid diagonally across the road some distance above the section where the effect of the water was noted, and will be turned parallel to the road and carried under one of the side ditches to an outlet.

*Tile Drains.*—Where the topography is flat and climatic conditions are such that the roadway at times becomes saturated because of underground water rising to a level is lowered by means of tile underdrains. The function of the tile drains in such cases is precisely the same as when employed in land drainage.

### Road Foundations

The transition from horse-drawn to motor traffic has come about so quickly that it has been impossible to revise construction methods and design rapidly enough to keep pace with traffic requirements. Formerly, the emphasis was placed on the construction of a smooth and durable wearing surface. The loads were not so heavy as to require minute attention to the foundation, and the wearing surface was constructed as a crust which was usually strong enough to bridge over weak places in the foundation. Now, the engineer must not only provide a wearing surface of sufficient durability and smoothness to be satisfactory for high-speed traffic, but must also provide a foundation of sufficient rigidity to carry loads about ten times as heavy as those formerly provided for.

The only safe plan seems to be to design a road slab of sufficient stability to distribute the loads over a large area of subgrade. With such types of surface as Portland cement concrete and monolithic brick, the foundation and wearing surface are integral. The foundation for roads with a bituminous wearing course may be of Telford, ordinary broken stone, or of Portland cement concrete, but the requirements on all main roads are becoming so rigid that Portland cement concrete is likely to prove most economical.

It is certain that to try to economize in the construction of the foundation course is to invite disaster, and the trend is decidedly toward heavier and better constructed foundations. The exact type and design will logically vary with the character of the soil upon which the road is constructed, but dependence cannot be placed on tile drains for keeping an absolutely stable foundation.



## SAND-CLAY ROADS

By W. S. KELLER

*State Highway Engineer of Alabama*

A WELL constructed and maintained sand-clay road is ideal for a reasonable daily traffic. Like a great many things that can be purchased at a low price, the sand-clay road has not been appreciated as it should, also like the cheap article purchased they are given generally half-hearted or no maintenance. A great deal has been learned within the last four or five years by road builders of this comparatively new kind of highway. From the first method of building a narrow roadway with a coating of from four to six inches of well mixed sand and mineral clay, has been evolved the 24 to 30-foot roadway with low crown, wide ditches, easy curves and low grades with from 10" to 12" of surfacing material. In other words it has developed that this new kind of road article is really worth spending a little money on and worth preserving.

It requires no little skill to so construct a sand-clay road as to make the surface entirely uniform and free from places with excess sand or excess clay. Unlike a gravel or macadam road the surfacing material comes from many pits, generally averaging one to the mile. This is one of the factors that makes the road cost much less than other surfaced roads. The varying qualities of the material can be easily detected by an experienced inspector, but with the most careful observation of all material going to the road an occasional wagon load will contain too much sand or too much clay with the resultant bad place in the surface. It is really difficult for a contractor to deliver to the engineer a perfectly finished sand-clay road. It requires careful maintenance for at least a year to bring the road to its prime. During the year all weak spots will develop. Where sand appears to be in excess additional clay can be worked in and vice versa.

The Alabama plans and specifications provide for a graded surface of 24 feet upon which the surfacing material is placed to a width of 16 feet. If the graded surface is of an insecure soil or of sand the entire 24 feet is surfaced. In any event when the road is finished not less than eighteen feet is surfaced, made possible by the spreading of the material with the grading machine.

The following is taken from the Alabama specifications:

"Surfacing Material. The surfacing material shall consist of top soil or natural sand-clay obtained from fields or pits designated by the engineer,

and as near the right-of-way as practicable; or, in the event that it is impracticable to secure suitable top soil or natural mixed sand-clay, the surface shall consist of an artificial mixture of sand and clay, the materials for which artificial mixture shall be obtained from places designated by the engineer. Before any surfacing material is used it shall first have been approved by the engineer. The surfacing material shall be free from trash or other foreign matter and contain no stones or boulders that would fail to pass a one and one-half ( $1\frac{1}{2}$ ) inch ring. Should any such non-road building material be placed on the road, it shall be removed by the contractor at his own expense."

"Construction Methods.—Case 1. Where the surfacing consists of either top soil or natural sand-clay that has been approved for use without the admixture of any material, it shall be evenly spread on the subgrade to such depth that when compacted the surface will have the compacted thickness shown on the plans. The material shall be dumped on the subgrade in longitudinal rows containing not more than one-third ( $1/3$ ) of a cubic yard to 10 lineal feet, and the number of rows shall be such that when the material is spread, the desired cross-section and thickness of surface will be obtained. After sufficient material has been dumped in this way for one hundred or two hundred (100 or 200) linear feet of road surface and before any part of the rows have commenced to pack, it shall be spread approximately to the required cross-section and harrowed to secure uniformity. The spreading may be done by hand or with a road machine in the following manner: (a) The machine shall be run over the road with the blade set so as to scrape off the tops of the piles and fill in the spaces between; (b) The outside edges shall be done over with the blade set so as to pull the top soil or sand-clay toward the center; (c) The grading machine shall be run over the shoulders so as to pull the shoulder material up against the surfacing material and thus bring the entire road surface approximately to the required cross-section. The surfaced portion of the road shall then be harrowed with either a tooth or disc harrow until uniform density is secured, after which the road shall be brought to the required cross-section and so maintained until accepted. The shaping or reshaping of the surface shall be undertaken only when the weather conditions are such that the loosened surfacing or shoulder material will be readily compacted by traffic to form a well bonded surface."

"Case 2. When the surfacing material is to consist of an artificial mixture of sand and clay, made by mixing the material of the roadbed with sand or clay from some other source, the construction shall proceed in the following manner: (a) The surface of the roadbed shall be thoroughly loosened by plowing and harrowing to a depth of from 4 to 8 inches, according to the nature of the two materials to be mixed, and as the engineer may direct. (b) The material to be added shall be dumped and spread in the manner described for Case 1. (c) The added material shall be thoroughly mixed and incorporated with the material of the roadbed. The mixing shall be done by means of plowing and harrowing and shall continue until the engineer is satisfied that the two materials are thoroughly mixed in proper proportion. A part of this mixing shall be done when the road is wet so that the surface will be puddled. (d) If, after mixing the two materials as above described, a deficiency of the added material is apparent at any point, such deficiency shall be immediately corrected by spreading more of the added material at that point and continuing the mixing as above described. (e) After the mixing is complete, as above specified, the road shall be shaped and maintained as provided in Case 1, except that wherever a poor mixture is observed, it shall be corrected by additional mixing or by adding necessary material and mixing."

"Case 3. When the surfacing material is to consist of an artificial mixture of sand and clay, both of which materials are to be obtained from with-



out the road, the construction shall proceed in the following manner: (a) The materials shall be spread in successive layers on the road and mixed in place. The engineer will determine the order in which the two materials shall be spread, as well as the depth of layers for each material. (b) The dumping and spreading of the materials shall be done as specified for Case 1. (c) The mixing of the two materials and the shaping and maintaining of the road shall be done as specified for Case 2."

"Basis of payment. The contract price per cubic yard for top soil or natural sand-clay surfacing material shall be full compensation for loosening, loading, spreading, and harrowing, and for hauling the surfacing material, as well as for shaping and maintaining the surface true to cross-section until the road is accepted. In the case of an artificially mixed surface the materials brought on to the road will be paid for at the contract price per cubic yard for top soil or natural sand-clay surfacing material, which will include all the items mentioned above except harrowing, and the contract price per square yard for mixing will be full compensation for all necessary harrowing, plowing or other mixing. Measurement of all top soil or sand-clay surfacing materials will be made in trucks, wagons or cars, as it is delivered on the road, except that where the surfacing material is hauled in scrapers or shoveled onto the road, it will be measured compacted in place on the road."

It is the observation of the writer that sand-clay surfacing will wear at the rate of one inch a year. Every two years the road should be resurfaced with about three inches of material measured before compacting and the resurfacing work should be done in the spring of the year. If the resurfacing is done in the dry summer months it will be found difficult to get a bond between the old surface and the new material.

Sand and clay is a great asset to the Southern States and as more and more miles of road is taken over by the States for constant and systematic maintenance the more will this kind of road be appreciated by the public.

## GRAVEL ROAD SUITABLE FOR LIGHT TRAFFIC

By CHARLES J. BENNETT

*State Highway Commissioner of Connecticut*

THE popularity of gravel as a road material is shown by the fact that of the 28,135 miles of Federal aid roads completed or under contract on November 1, 1921, over 10,000 miles or nearly 36 per cent were surfaced with gravel.

In spite of the fact that a tremendous amount of money is being spent in the construction of State and Federal highways throughout the United States, there must remain a tremendous number of miles of highway which cannot be improved by either one of these agencies. These highways at the present time are, many of them, constructed of inferior material even where deposits of good material are available.

It is evident that the improvement in methods of transportation demand an improvement in the type of road constructed on the ordinary highway, and for this purpose there can be no material so nearly universal and so satisfactory as gravel. There are few sections of the country where gravel is not available, and there are few roads which could not be improved by the use of gravel intelligently applied.

Types of gravel road vary between very wide limits. In general, they may be classified under three heads; namely, the roads built of gravel by the feather-edge method; the road built of gravel by the trench method, and the road built of screened gravel. These types are classified in the order of their cost of construction, the feather-edge method road being the cheapest type. The cost increases as refinements are added in the construction of the road.

In places where considerable gravel occurs, it is possible to build roads by either one of the first two methods without doing very much work on the material, but where the material is unsatisfactory or where a higher type of construction is necessary, the use of screened gravel is advised.

In general, roads of this type are easily repaired where the material is available and of the same character of which the road was originally built. It is comfortable to pass over, and unless subjected to excessively heavy traffic, is one of the most satisfactory types of road at present known.

It is impossible to give an average cost of construction for roads of this type, as methods of construction are different, and the cost of labor and material varies in different sections of the country.



Gravel for road-building purposes should consist of material formed from hard stone particles. It should not contain too much loam or clay, probably not in excess of from 8 to 15 per cent of this material in case the road is not to be treated with bituminous coating. If treated with bituminous coating, a gravel road should be free from clay or loam, and should present to the bituminous material a clean, sharp sand and gravel surface.

The above statement gives rise to a general division in the construction of gravel roads under two heads: First, those gravel roads which are not to be treated; and, second, those that are. When a road is not to be treated with bituminous material, it should contain, as stated above, from 8 to 15 per cent of binding material, while in the second case, binding material should be entirely eliminated and the road made up of porous material which would allow the bituminous surface to secure a firm grip on the stone particles.

Roads of this type are easily repaired. At the same time they are easily destroyed when subjected to heavy and fast travel. In other words, when the travel increases beyond what is known as a light amount of traffic—up to and including five hundred motor vehicles per day with no trucks in excess of eight tons, total load, in the wet season of the year—the road should be included in the State highway type of construction and built with a heavier and stronger surface.

The ordinary maintenance of gravel roads on the lighter traffic roads can easily be taken care of with a split log drag or some modification of this instrument. The drag should be used continuously and immediately after rain storms or when the winter is over and the frost is coming out of the ground.

The reconstruction of gravel roads should be done in the spring when the road is soft and new material can be easily incorporated with the old.

The cost of maintenance varies between wide limits. This variation is due to the variations in the kind and weight of traffic, the character of gravel, the width of the road and the climate in which it is built.

## ASPHALT HIGHWAYS

By THE ASPHALT ASSOCIATION

**A**SPHALT is the oldest waterproof adhesive known to man. It invariably originates in petroleum, whether produced by natural agencies or at a petroleum refinery. In simple language it may be defined as a semi-solid sticky product formed by partial evaporation or distillation of certain petroleum. Petroleum which yields asphalt by these simple processes is known as asphaltic petroleum and actually carries the asphalt dissolved in relatively volatile oils. When these oils are removed by evaporation or distillation the asphalt is left.

Asphalt formed at or below the earth's surface by natural processes of evaporation or distillation is commonly termed native asphalt. If produced in a still at a refinery the term petroleum asphalt is sometimes used to describe it. There is no essential difference between native asphalt and petroleum asphalt except that the former has usually become mixed with mineral or vegetable matter, while the latter is practically 100 per cent pure asphalt.

Pure asphalt belongs to a class of materials known as bitumens, which dissolve completely in the chemical known as carbon disulphide. Ordinary vegetable and mineral matter do not dissolve in carbon disulphide. If mixed with asphalt they can therefore be separated by treating the mixture with carbon disulphide and filtering off the dissolved asphalt. This method is used to determine the percentage of asphalt present.

Asphalt formed within the earth sometimes seeps to the surface through fissures in the overlying rock formation and collects in natural depressions. Seepages of asphaltic petroleum may also collect in a similar manner and through loss by evaporation gradually harden to asphalt. Thus an asphalt spring or asphalt lake is formed depending upon the size of the deposit.

In certain cases porous rock formations impregnated with asphalt are exposed by erosion and any resulting seepage seldom has an opportunity to collect in paying quantities. The rock, usually a sandstone or limestone, permeated with asphalt, is known as rock asphalt. Under favorable conditions such material is quarried and crushed, after which it is softened by heat and laid as a paving material in much the same manner as will be later described for artificial mixtures of asphalt and mineral matter.

In certain instances, seepages of asphalt collect in large veins or faults in the rock structure and here, under the action of heat,



become hard and brittle. Such products are mixed in the same manner as coal. They are usually of little interest in the paving industry, but are utilized mainly in the manufacture of asphalt products for various other purposes.

### **Refining Lake Asphalt**

Crude lake asphalt must invariably be refined before it is suitable for use in highway construction. The refining process is conducted in large metal tanks heated by means of steam coils and equipped with perforated pipes through which air or steam is forced for the purpose of agitation so as to prevent local overheating and consequent injury of the asphalt. The chunks of crude asphalt are thrown into the tank and melted. The temperature is then gradually raised until all water and light oils are evaporated. Vegetable matter floats to the surface and is skimmed off while the coarser particles of mineral matter settle at the bottom. The refined asphalt may then be drawn off and barrelled. It is invariably too hard for direct use and must be softened to suitable consistency by mixing it with a fluid petroleum product known as flux oil.

The fluxing process is sometimes conducted in the original tank after the crude asphalt has been refined. It consists merely in agitating the asphalt with the proper amount of flux oil until a homogeneous product of the desired consistency is produced. When the fluxing process is not carried out at the refinery the refined asphalt must be fluxed at the paving plant before it is mixed with the other constituents of the pavement. Refined asphalt, too hard for direct use, is commonly termed R. A. When fluxed to suitable consistency it is known as asphalt cement and often called A. C.

### **Recovering Asphalt from Petroleum**

Asphalt is refined from crude asphaltic petroleum in 50,000 gallon cylindrical iron stills, set horizontally and heated from below. Inside they are equipped with perforated pipes through which steam is forced during refining. The process is very simple and quite similar to that described for lake asphalt except that, because the volatile products have considerable commercial value, they are carried off from the top of the still through a vapor line and condensed in water-cooled coils.

The temperature of the oils in the still is never allowed to exceed 600° or 700° F. and this coupled with steam agitation prevents injury to the asphalt left behind. As distillation progresses the material remaining in the still becomes more and more viscous until finally a semi-solid or solid residue is produced. Distillation

is stopped when the asphalt has reached the desired consistency. No fluxing is therefore necessary.

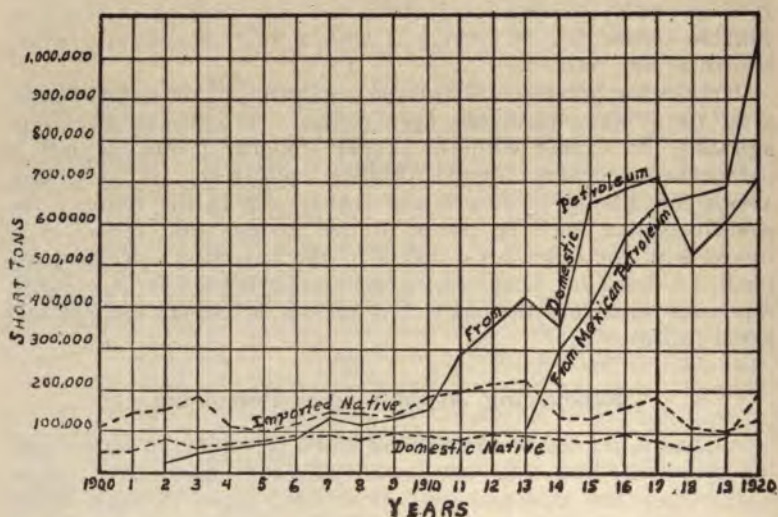
In the manufacture of asphalt fillers for brick pavements it is customary to blow air through the melted asphalt at a certain stage in the refining process. This produces a higher melting point asphalt than would be produced by straight steam distillation.

Except for water which is removed by distillation, petroleum is practically pure bitumen. It therefore follows that petroleum asphalt is pure bitumen, and its use does not have to take into account the presence of vegetable and mineral matter.

### Asphalt Production and Importation

The accompanying chart plotted from statistics of the Geological Survey shows the growth of the asphalt industry in the

#### PRODUCTION & IMPORTATION OF ASPHALT



United States. In these figures the survey includes road oils and fluxes. It should be noted that the domestic native asphalts, mainly rock asphalt contain less than 10 per cent of asphalt proper. It is seen that until 1911 imported native asphalt, mainly Trinidad and Bermudez, led all others. In 1902 petroleum asphalt was introduced in commercial quantities and its production from domestic petroleum has grown very rapidly since 1910. Even more remarkable has been the production from Mexican petroleum since 1913. It will be noted that in 1920 about thirteen times more



asphalt was produced from petroleum than was imported from Trinidad and Venezuela.

### **Asphalt Types of Construction**

Asphalt is used in the construction of 4 distinct types of asphalt pavement; asphalt macadam, asphaltic concrete, sheet asphalt and asphalt block.

The asphalt macadam consists of a course of broken stone to which melted asphalt is applied so as to coat and penetrate the entire course. Stone chips are then spread to fill the surface voids and followed with a seal coat of hot asphalt and stone chips.

Asphaltic concrete consists of an intimate mixture of asphalt, broken stone or gravel sand and mineral dust laid and compacted hot usually in a single course. A seal coat is sometimes used to finish off the surface.

Sheet asphalt is constructed in two courses. The lower, an asphaltic concrete, is known as binder course. The top course is composed of a mixture of asphalt with carefully graded sand and mineral filler.

Asphalt blocks are composed of asphalt concrete, molded under great pressure. The blocks are laid upon a sand or mortar cushion in the same manner as brick.

As a filler for brick pavements hot asphalt is ordinarily squeezed over the surface of the brick, after they have been laid, so as to fill the spaces between the brick. For stone block pavements it is customary to use a grout composed of a mixture of equal parts of hot sand and asphalt.

For expansion joints for monolithic pavements asphalt is often premolded into strips to be inserted in the joint slots.

### **Consistency of Asphalt**

For every type of construction in which asphalt is used it is of the utmost importance that the asphalt cement be of proper consistency. Consistency is determined by means of a penetration machine which records the distance that a standard needle will penetrate a sample of the asphalt.

The test is ordinarily made by bringing the needle under a load of 100 grams in contact with the surface of the asphalt, maintained at 77° F. and noting the distance that it penetrates during a period of 5 seconds. If the needle penetrates 50 units the asphalt is said to have a penetration of 50. It is evident that by this test the harder the asphalt the lower is its penetration. While there are a number of other tests for asphalt the penetration test is the most important and in refining is used as a control of consistency. This test is almost invariably included in asphalt specifications.

For the four main types of asphalt pavements which have been

briefly described, the following table shows the proper limits of penetration of the asphalt cement. It will be noted that for each type the controlling factors are traffic and climatic conditions. The lowest penetration asphalt, or in other words, the hardest, is required for asphalt block, in order to allow for handling without injury. Considering the other three types the following should be noted: Other conditions being the same, penetration of the asphalt decreases as the mineral aggregate becomes finer. For each type the penetration decreases as traffic becomes heavier and in like manner the penetration decreases as the climate becomes warmer.

### Asphalt Macadam Construction

Coming now to the use of asphalt in highway construction the asphalt macadam may be first considered. This pavement is usually laid upon an old road bed or upon a well consolidated broken stone base. A course of clean broken stone averaging about  $2\frac{1}{2}$  inches in diameter is first spread and rolled to interlock the fragments. Hot asphalt is then applied at the rate of approximately  $1\frac{1}{2}$  gals. per square yard.

One method of application is by means of hand pouring pots equipped with wide flat spouts. By carrying the pot directly across the road with the spout close to the surface very uniform distribution may be secured if the distance to be covered is correctly measured for the quantity of asphalt in the pot.

PENETRATION LIMITS FOR ASPHALT CEMENT

Type of Pavement	Traffic	Temperatures		
		Low	Moderate	High
Asphalt Macadam...	Light.....	120-150	90-120	80-90
	Moderate.....	90-120	90-120	80-90
	Heavy.....	80-90	80-90	80-90
Asphaltic Concrete...	Light.....	60-70	60-70	50-60
	Moderate.....	60-70	60-70	50-60
	Heavy.....	50-60	50-60	50-60
Sheet Asphalt.....	Light.....	50-60	50-60	40-50
	Moderate.....	50-60	50-60	40-50
	Heavy.....	40-50	40-50	30-40
Asphalt Block.....	Light.....	15-25	15-25	10-15
	Moderate.....	15-25	15-20	10-15
	Heavy.....	15-20	10-15	5-15
Grouted Joint Filler...	All.....	80-100	60-80	50-70
Poured Joint Filler...	All.....	40-50	40-50	30-40



When the asphalt is applied by hand pouring it is ordinarily melted and heated in portable kettles at the side of the road. Before application it should be raised to a temperature of 275 to 350° F. so as to be sufficiently fluid to penetrate the broken stone course for its entire depth which is about 2½ inches. If not hot enough it will congeal at the surface and will not penetrate uniformly, while if heated too high its binding properties will be injured and it may catch fire. Careful control of temperature with a thermometer is therefore advisable.

Application of the hot asphalt is frequently made by means of a large pressure distributor of which there are a number of satis-



Heavy Bus Traffic on Sheet Asphalt, Fifth avenue and Fifty-ninth Street, New York City

factory makes. Such distributors, mounted on a motor chassis pass over the broken stone course at a uniform rate of speed and distribute the asphalt for a width of 6 to 8 feet, from a line of nozzles set close to the road surface in a frame at the rear of the machine. The asphalt is carried in a large cylindrical tank and is forced under pressure through the spraying nozzles. When properly designed and operated these distributors spread the asphalt very uniformly at any desired rate of application. Overlapping treatment should be carefully avoided and any places missed by the distributor should be treated by hand pouring.

Immediately after the first application of asphalt has been made and progressing with it, a thin uniform layer of ¾-inch broken stone is broadcasted over the surface in just sufficient quantity to fill the surface voids after rolling. When the pavement has been thoroughly rolled, it is carefully broomed in order to remove all surplus loose material, and a second application of hot asphalt is made at the rate of approximately one-half gallon per square

yard. If hand pouring pots are used the lines of distribution should preferably cross those of the first application. When the second treatment is covered with small size broken stone and rolled a waterproof seal coat is formed.

In finishing the pavement it should be rolled until the surface is smooth and uniform. The use of an excess of broken stone cover should be avoided as it will grind up to dust and promote early disintegration of the seal coat.

In the construction of asphalt macadam it is essential that the broken stone be clean and dry when the asphalt is applied, and that the air temperature should be relatively warm. The course of large broken stone should be of uniform size so as to facilitate uniform distribution of the asphalt throughout. When properly constructed this type of pavement will successfully carry relatively heavy traffic, and it offers the advantage of low first cost.

### Asphalt Paving Plants

The materials for asphaltic concrete and sheet asphalt pavements are prepared at an asphalt plant which may be stationary, portable or semi-portable, according to the volume and distribution of work in a given locality. The function of the plant is to manufacture from mineral aggregate and asphalt a hot paving mixture which will be delivered upon the road or street under such conditions that it may be immediately spread to the desired thickness and compacted by rolling. All details of its operation should be under competent supervision.

A brief description of one type of plant will serve to illustrate the general plant operation. At one end is placed a continuous elevator of the belt and bucket type into which broken stone, sand or other mineral matter is fed from nearby storage piles. The elevator discharges into a cylindrical metal drum set over a fire box. As the drum revolves the aggregate passes through and is dried and heated by meeting the hot gases from the furnace which discharge through the drum. The hot aggregate is then lifted by means of an elevator to a hot storage bin, sometimes being first screened into different sizes. The bin discharges into a measuring box on the mixing platform where operators are stationed to proportion and handle the mix. Here the proper quantities of hot aggregate and asphalt are weighed out for each batch to be mixed. The asphalt is heated in kettles, and here, if too hard it is also fluxed to proper consistency. It is forced through pipes to a weighing bucket on the mixing platform. The mixer is set so as to discharge directly into wagons or trucks below the platform and usually consists of an iron box equipped with a double set of blades revolving on two horizontal shafts extending through the box.



The mixer is first charged with the mineral aggregate, including limestone dust or Portland cement filler, if any is to be used. After preliminary mixing the hot asphalt is added and mixing continued for one or two minutes until every particle is uniformly coated. The mix is then dumped into a truck and another batch prepared.

### Asphalt Mixture

There are two distinct types of asphaltic concrete mixtures, one known as coarse aggregate and the other as fine aggregate. In the former, broken stone or gravel averaging  $1\frac{1}{4}$  inches in diameter predominates, the sand and limestone dust serving mainly as void filling material. In the latter, sand predominates, and broken stone of about  $\frac{1}{2}$  inch in diameter is used to only a limited extent. In this type, as well as the sheet asphalt, it is extremely important that the sand meet certain grading limitations in order to secure a mechanically stable mixture.

Careful inspection of the following details is necessary in plant operation. The temperature of both aggregate and asphalt must be controlled within comparatively narrow limits depending upon the type of mix. The grading of the mineral aggregate must be tested and also kept within suitable limits and proper proportions of the different constituents of the mix must be accurately maintained.

### Laying Asphalt Mixtures

It is important that the asphalt paving mixture be delivered at the site of work at the proper temperature for spreading and compacting, usually between  $225^{\circ}$  and  $325^{\circ}$  F. In cool weather it should be protected during the transportation by means of a tarpaulin. The loads should never be dumped directly in place, but should be shoveled from piles. It is then uniformly spread by means of hot rakes to such depth as after compaction will produce the desired thickness, usually  $1\frac{1}{2}$  to  $2\frac{1}{2}$  inches. If curbs or gutters have not been previously constructed the mix should be spread between temporary side supports, such as planks of suitable thickness which are allowed to remain in place until after the pavement has been compacted by rolling.

While the mix is still hot and as soon as possible after raking it should be compacted by rolling with a self-propelled roller. For this purpose a 10-ton three-wheel roller may be used on coarse aggregate mixes, but tandem rollers weighing 7 to 10 tons are more commonly employed for all types of mixes.

Rolling should start longitudinally at the sides and proceed toward the center of the pavement. After longitudinal rolling it is then advisable to subject it to diagonal rolling in two direc-

tions, the second diagonal rolling being made to cross the lines of the first. When the pavement is sufficiently wide it should, in addition, be rolled at right angles to the center line. To prevent adhesion of the hot mixture to the roller the wheels should be lightly mopped with water or kerosene. Rolling should be continued until no further compression is possible in order to produce a dense stable pavement.

Joints are necessary at the end of each day's work and may be made in a number of ways. An excellent method is to lay planks of suitable thickness directly across the road and to roll the mix against these planks. Just before the laying of the mix is continued the planks are removed and the exposed edge cut back to the full depth and lightly painted with hot asphalt. Properly made joints are invisible after completion of the pavement.



Sheet Asphalt on Macadam Base, Burlington Co., N. J.

The coarse aggregate asphaltic concrete pavement is ordinarily finished off with some sort of seal coat to fill the surface voids as otherwise the texture of the surface is rather rough and open. Sometimes a very thin layer of hot asphalt-sand mix is spread over the surface and rolled in. In other cases hot asphalt is squeezed over the surface at the rate of  $1/5$  to  $1/3$  gallon per square yard and covered with a light coating of stone chips.

Fine aggregate asphaltic concrete and sheet asphalt pavements do not require a seal coat as the surface closes up and becomes smooth and dense under compaction. They are usually finished off with a light sweeping of limestone dust or Portland cement just before the final rolling. This serves to fill the very small surface voids and gives the pavement a pleasing appearance.

No seal coat or other finish is given the asphaltic concrete lower, or binder, course of the sheet asphalt pavement. Such course belongs to the coarse aggregate type and its surface is purposely left



somewhat open in texture so that the wearing course mixture will knit firmly to it.

Although sheet asphalt is the most popular type of city pavement, asphaltic concrete has been laid in many municipalities, and its use on important state and county highways has grown rapidly during the past fifteen years. Portland, Oregon, with some 200 miles of asphaltic concrete, appears to take the lead among American cities in such construction.

That properly constructed asphaltic concrete will successfully withstand intensive traffic has been demonstrated by numerous examples, such as sections of the famous heavily traveled Michigan Boulevard, Chicago. A decided advantage possessed by asphaltic concrete over many other types is that it may almost invariably be made to utilize available local material.

Of all the higher types of pavement sheet asphalt is more extensively used in cities than any other. New York and Chicago each have approximately 1,000 miles. Fifth Avenue, New York, which is said to carry the heaviest travel of any street in the world, is paved with sheet asphalt. In addition to the thousands of quick moving business and pleasure vehicles which daily traverse this pavement, there are in operation 275 motor buses, weighing when full  $8\frac{1}{2}$  tons each. Sections of this pavement from 5 to 20 years old give ample evidence of the adaptability of sheet asphalt to severe traffic conditions. In addition, it is of interest to note that the longest recorded tire life for motor buses has been obtained on Fifth Avenue.

### Asphalt Block Pavement

The asphalt block pavement is constructed of blocks composed of a dense fine aggregate asphaltic concrete. These blocks are manufactured at a central plant and sold directly to the consumer. The asphalt block plant is similar in many respects to an ordinary paving plant, but is equipped with powerful hydraulic presses for moulding the block from hot asphaltic concrete. Upon emerging from the press the blocks are carried on an endless belt under cooling water and are then stored in piles until needed.

In the pavement the blocks are set very close together upon a thin cement mortar bed and are not rolled. A light covering of sand is used to finish off the pavement.

Upon being subjected to heavy traffic the asphalt blocks frequently amalgamate at the surface so that the joint spaces are practically eliminated and the pavement closely resembles sheet asphalt. When, however, the asphalt cement is very hard and the traffic relatively light the appearance of a block pavement is retained. To reduce slipperiness on steep grades the blocks are

sometimes laid with cement grout joints which are tooled back to a depth of  $\frac{1}{2}$  inch. Special forms of anchor block having a projection which is forced into the mortar bed are sometimes



Asphalt Concrete on Old Macadam Foundation, Logan Boulevard, Chicago, Ill. Laid in 1911

placed in the pavement in single courses where shoving under traffic is otherwise likely to occur.

### Use of Asphalt Filler

Asphalt is widely used as a filler for both brick and stone block pavements. One of the chief advantages of the asphalt filler is that it does not produce a rigid monolithic structure. The asphalt serves as a protective cushion to the brick, prevents cracks and efficiently waterproofs the pavement. By its use the noise of traffic is greatly reduced and repairs are readily made.

In the case of brick pavements a blown type of hot asphalt cement is flooded over the pavement after the bricks have been laid and rolled. It is then squeegeed into the joints and over the entire surface which is finished with a dressing of sand, thus producing an asphalt mat.

In stone block pavements a hot grout of asphalt and sand is used in like manner.

In constructing monolithic pavements it is necessary to make adequate provision for expansion and contraction. This is most frequently done by inserting longitudinal and transverse joints where needed. Joint slots are constructed extending the entire



depth of the pavement and these are filled with a compressible or elastic material.

Blown asphalt is widely used in the construction of expansion joints and when melted may be poured directly into the joint slots. In some cases a prepared asphalt filler in the form of premolded strips is inserted in the slots, and the surface of the joint sealed with a hot smoothing iron.

Asphalt is used to a considerable extent in maintaining badly cracked monolithic pavements until it became necessary to resurface them. As they appear such cracks should be filled with hot asphalt poured from a narrow spout pot so that a minimum amount overlaps on the surface. The joint should then be lightly sanded. With care such cracks may be filled just flush with the surrounding area so as to produce a reasonably smooth surface. Overfilling creates ridges in the pavement which make rough riding.

### **Maintenance of Asphalt Pavements**

In common with all other classes of pavements, those constructed with asphalt will eventually wear out and must be renewed. With careful maintenance, however, the life of a well-constructed asphalt pavement may be extended over a long period of years. Recent paving statistics obtained from the leading cities of the United States show that the oldest sections of asphalt pavement still in satisfactory condition range from 20 to 46 years.

The maintenance of asphalt pavements may be considered under two main heads: renewal of seal coat and replacement of worn-out spots. In the first case, which involves only the asphalt macadam and the coarse aggregate asphaltic concrete types, the seal coat may be rejuvenated or renewed by a surface treatment with asphaltic oil or asphalt cement and a cover of broken stone, in a manner similar to that used in the original construction.

Wornout or rough spots in the pavement require patching, and this is ordinarily done by first cutting out the defective area so as to produce excavations with approximately vertical sides. There are two types of patches: the penetration patch and the mixed patch. The former is made by filling the hole with broken stone of suitable size which is tamped or rolled into place. Hot asphalt is then poured over the stones so as to bind them together, the surface voids filled with fine broken stone and the patch finished with a seal coat. Mixed patches are made by filling the hole with hot mix, preferably of the type used in original construction. Sometimes, however, an emulsified asphalt, which may be diluted with water, is used in the preparation of a cool mix for the same purpose. In any case the mix should be thoroughly compacted so as to form a patch which is flush with the surrounding surface.

When too little or too hard an asphalt cement has been used in original construction, when the aggregate is improperly graded, or when the pavement has aged with little or no traffic, cracks sometimes form in fine aggregate asphaltic concrete and sheet asphalt pavements. In such cases it is usually advisable to attempt no repairs to the cracks until the edges have worn away and roughness has developed. The pavement may then be cut back for some distance on each side of the crack and a patch put in.

When a sheet asphalt surface has become so old and worn as to require renewal the surface heater method of resurfacing has been found quite satisfactory. The surface heater consists of an apparatus for bringing hot air or superheated steam into contact



Asphalt Concrete on Asphalt Concrete Base, Sacramento, Calif. Built in 1905

with the pavement until the old mix has been softened to the required depth, usually from  $\frac{3}{4}$  to 1 inch. All burned material is then removed from the heated area and immediately replaced with fresh hot mix, which is spread and compacted as in original construction.

### Merits of Asphalt Pavements and Foundations

The asphalt paving industry could not have reached its present proportions had it not been for the intrinsic merit of asphalt pavements, which, as compared with other existing types, have been given a very high rating in tables of weighted factors prepared by leading engineers.

It is generally recognized that properly constructed asphalt pavements are highly resistant to impact and abrasion under rapidly moving traffic and offer very low tractive resistance. They



are impervious, readily cleaned and therefore highly sanitary. They wear slowly and uniformly under traffic and are easily repaired. After years of service they may be resurfaced with little or no waste of existing material, and, in addition, may be opened to traffic a few hours after construction.

Recently the more general use of asphalt foundations for asphalt pavements has engaged the serious consideration of many engineers. In common with other types of pavements, failures are often the result of foundations which are inadequate to meet local subgrade, climatic and traffic conditions. The failure of a foundation will of necessity produce an unsatisfactory surface condition if it does not result in the absolute failure of the pavement proper. Under certain conditions, gravel, broken stone, slag and Portland cement concrete may be successfully utilized as a foundation for asphalt pavements, and old roads or pavements of almost any type may be so used. All have their place.

There is one class of foundation involving the use of asphalt, commonly known as "black base." It may be of either the asphalt macadam or coarse aggregate asphaltic concrete type. Extending over a period of 40 years "black base" has been in successful use in a number of cities. It is used extensively in conjunction with an asphalt surface course in California and Oregon and is generally regarded in that section as highly satisfactory. Because of its peculiar adaptability to withstand modern traffic conditions it appears likely to be much more generally adopted in other sections of the country. The asphalt base is a powerful shock absorber, is waterproof, little subject to cracking, forms a close bond with the overlying pavement and is easily constructed. Experienced engineers are coming to believe that the all-asphalt highway has a promising future.

## USE OF BITUMENS IN MAINTENANCE AND RESURFACING

*Revised by B. A. ANDERSON*

*Of the United States Bureau of Public Roads*

**S**URFACE applications vary widely in character, according to their purpose. In most cases such an application is essentially a maintenance measure, but in the case of the bituminous mats or wearing courses used in California, or the mats now laid on new water-bound macadam, the first cost of such work is essentially a part of the first cost of the improvement. The practice in making such surface applications of any general type varies widely in different parts of the country, more widely than the practice in any other branch of road work. Whether greater uniformity will prove desirable or the work can be done successfully by a wide variety of methods cannot be definitely determined until the records of such work and of the traffic on roads are kept with more detail and uniformity than at present. The widespread interest in the subject is one of the leading characteristics of highway affairs, and is an evidence of the conditions mentioned.

Such applications of bituminous materials are made upon many types of road surface, including shell, gravel, broken stone or slag macadam, bituminous macadam, bituminous concrete, and cement concrete. When the purpose of the treatment is essentially that of a dust palliative, the bituminous material used is of relatively thin fluid nature, and no covering material is ordinarily required; but when a protective mat over the road surface is desired, a heavier material of more adhesive character is applied and covered with solid material such as sand, clean gravel, stone screenings, or sometimes earthy material. Petroleum and tar products which may be utilized upon road surfaces are discussed in other chapters of this yearbook.

In the surface treatment of roads it is necessary to consider the condition of the road surface before application. It is important that all ruts, holes, bumps, etc., be eliminated or repaired and that the surface be in the best possible general condition. A light film of dust may be desirable where a dust palliative only is applied, but where any mat treatment is contemplated it is essential that the surface be as clean and free from dust as possible. The amount of clay in a gravel surfacing which is subsequently to be treated should be kept to a minimum: largely on account of the



presence of this fine material, the success of bituminous treatments upon gravel roads has been quite varied. The best results are obtained on coarse, hard gravel, with only fines enough to hold the stone in place.

It has been found that a surface application on a new water-bound macadam road may prove unsatisfactory, although if the road is exposed to traffic for three months the desired results are obtained if the treatment is properly carried out. This is probably due to the large amount of fine, lightly bound dust on the roadway, which is removed by the early traffic, or to the greater stability of the road as a result of its consolidation by traffic. In New York, macadam roads finished so late in the fall that they cannot have three months' wear before winter are sometimes given a surface application of calcium chloride as a temporary protection against raveling during the months that must elapse before bituminous surfacing can be placed.

In making thin surface applications to an old road that is thick enough to carry the prospective traffic and has a surface in fair condition, the ruts and holes must first be patched. This is best done several days in advance of the surfacing. It is desirable to cut the edges of a hole so as to secure vertical faces to which the new material will adhere properly; a patch with a feather edge is liable to push ahead by traffic and prove unsatisfactory. Each hole or rut is swept clean, painted with bituminous material and filled with  $\frac{3}{4}$  to  $1\frac{1}{2}$ -inch stone and binder and thoroughly tamped into place. The stone and binder are often mixed at a central point and carted along the road by the patching gang, for use where required. Bituminous materials which may be used cold are an advantage in this work. Just before the surfacing is done, the road is swept thoroughly, often with some type of revolving broom. Sometimes wire brooms are used first and then fiber brooms. The oil or tar is applied hot or cold, according to viscosity, at the rate of about 0.2 to 0.5 gallon per square yard, as the engineer considers best, and then covered with clean screenings, granulated slag or pea gravel at the rate of from 25 to 60 pounds per square yard. It is not unusual to apply too much covering material, which weakens the mat, and is objectionable in that the excess removes a portion of the bitumen from the road, and also causes excessive dust until it is carried or blown away from the roadway. It is far better to use a minimum quantity of covering material, even though it may be necessary to "touch up" occasionally until the mat is consolidated under traffic.

Usually bituminous materials are applied with pressure distributors, but on small work application by hand and brooming is sometimes employed, with entirely successful results. If the screenings are distributed by hand they should be previously deposited in piles at convenient intervals along the roadside. They

are, however, sometimes distributed by spreader carts. The road may be opened to traffic almost immediately after application of the mineral cover.

If the tar or oil rises through the screenings, or "bleeds," in hot weather, more screenings should be spread over those places. If the road is used mainly by automobiles, a thin covering of screenings is sometimes spread first and later a covering of sand or other fine material, to act as a filler and prevent the tires from dislodging the screenings.

Double applications are sometimes made, particularly on gravel roads. A thinner material is first applied as a priming coat or to act as a binder between the road surface and the heavier material applied afterward, usually heated. The second application essentially provides for the surface carpet, and to ensure its adherence, only sufficient cover material is applied after the first application to prevent difficulties in operating the distributor during the final application.

On the Illinois highways, when a double application is made, about  $\frac{1}{4}$  gallon per square yard is used on each application, and the preferred covering is torpedo sand,  $\frac{1}{8}$  to  $\frac{3}{8}$  inch in size, but clean stone chips are also employed. The total amount of covering material with such a treatment is one cubic yard for each 125 square yards of road. When a single application is made  $\frac{1}{3}$  to  $\frac{1}{2}$  gallon of oil per square yard and a cubic yard of torpedo sand for every 150 square yards of road are employed.



## USE OF TARS IN ROAD BUILDING AND MAINTENANCE

*By* PHILIP P. SHARPLES

**M**AINTENANCE and repairs are road problems that are immediate and eternal. The road has not yet been invented that will stand modern traffic without deterioration. If the capital expended in new roads is not protected by maintenance and repair, it is quickly dissipated.

Just a little illustration. A macadam road has been carrying the traffic. Neglected, it has fallen into disrepute and it is proposed to replace it with a forty-thousand-dollar pavement. Right at the outset a charge for interest on the new pavement of two thousand dollars per year is incurred, while a fund for replacement and annual repairs and maintenance would incur an additional expense of twenty-five hundred dollars a year, if we assigned a life of twenty years to the new pavement, and twenty years is a long time in paving annals. Most pavements go much quicker.

Stated in other words, a fund of forty-five hundred dollars a year has been created by the thought of a new road. If the old macadam can be fixed up to carry the community's traffic for any less sum per year, the community's pocketbook is the gainer.

Methods for saving macadam roads and methods for building pavements with refined tars have been very satisfactorily evolved during the last two decades. Experiments, begun in France in 1901 and continued in the United States, early led to the development of a refined tar which could be applied hot to an existing macadam road and make it resistant to automobile traffic. Some of the earliest roads treated in the United States, like the Revere Beach Boulevard north of Boston and the Newton Boulevard west of Boston, have carried a constantly increasing traffic without rebuilding and at annual repair costs that cannot be matched by any other type of road.

Apparatus has been invented for applying hot bituminous materials in thin, even coastings of a half gallon or less to a square yard. The costs have been reduced and the troubles of application have been eliminated by the automotive power distributor.

Great care is necessary in choosing and applying the stone or gravel which must be used over hot-surface treatments. Good clean stone chips of very hard stone make the best cover and should be put on at the rate of one cubic yard to three hundred square yards, and then rolled with a road roller. A good hard

silica gravel of the same size may often be substituted for the stone.

Sand, dirty stone or soft stone are almost sure to cause the development of waves in the coating. Excess of tar must also be avoided, especially on retreatments. Tar, however, has much less tendency to form waves than other bitumens.

Surface treatments with hot applications should only be used over macadam roads that are in good condition. As a mat is formed, it must have adequate support or traffic soon destroys it.

A large part of the cost of early hot-surface treatments was in heating the material and in the high cost of the cover. Experiments led to the development of a tar that could be applied without heating. They were so far successful that the cold material has largely taken the place of the hot application except for park and boulevard work.

The new material, in addition to being much cheaper to apply, showed other advantages. It was found to possess a penetrating power far beyond any other binding bituminous material. It could be applied to roads that were not in sufficiently good condition to warrant the hot-surface treatment, much less skill was required to put it on correctly, and, above all, much less cover was required and more liberties could be taken with the quality of the cover.

The amount required per square yard is usually less. Although a half gallon per yard is indicated for the first year, second treatments are usually one-quarter gallon and subsequent treatments even less.

The road must be carefully cleaned and patched and the road must be in reasonably good condition. A surface treatment cannot make a bad road good. It cannot supply drainage, correct alignment, or supply a base. Its only province is to preserve a road that is worth preserving.

The cold-application tar is put on with spraying apparatus, preferably motor-driven, and is covered with pea-stone or grit. Good sharp sand may be used. The quantity must be closely judged, and only enough (usually one cubic yard to three hundred square yards) put on to blot up the excess of refined tar. An excess of cover overloads the bitumen and destroys its effectiveness. It is better to err on the side of using too little cover. The road may be objectionable to traffic for a few days, but in the end will come out all right.

Roads treated with cold-applied tar show very little tendency to form waves. Care must be taken, however, in repeated treatments, not to accumulate an excess of bitumen. The bitumen added from year to year should only be sufficient to replace that lost by attrition. As in the case of hot-surface treatments, a larger and harder cover prevents waving. The cold treatments differ



from the hot treatments in that it is aimed not to create a mat, but to penetrate the treatment into the road itself.

Roads with cold-tar surface treatments sometimes show a tendency to break in cold, wet weather. The result is due entirely to the condition of the underlying road. An examination will usually reveal poor drainage, lack of stone in the macadam, or a heavy coating of fine material beneath the surface coating. To endure, the tar treatment must be on the stone of a good macadam.

Cold surface treatments of refined tar have been used on gravel roads. Not every kind of gravel can be treated. Only gravels



**Maintenance Crew, New Hampshire State Highway, repairing road with Bituminous Cold Mix**

containing particles of hard rock of assorted sizes up to one inch or more and with a minimum clay content have so far yielded success.

Some of the gravel roads in parts of New England have been traffic-proofed to such an extent that three thousand automobiles a day or more are carried over gravel roads that previously became intolerable under a traffic of as many hundred vehicles. Good stretches of this kind of treatment may be seen on the Kittery-Portland road in Maine. During the summer the road may with difficulty be distinguished from a surface-treated macadam.

The automobilist, in judging surface treatments and their success, should keep in mind the wide variety of roads to which they are applied and the aim of the road engineer in making the appli-

cation. Poor roads are often treated with dust-laying oils and are often confused with the better class of roads, preserved and strengthened with the more permanent tar treatments. Splendid examples of tar-surface applications are seen on the State roads of New England, of New York, of Pennsylvania, of Maryland, of Ohio, of Michigan, of Wisconsin, and in other sections where macadam is built.

The successful maintenance of all kinds of treated roads depends to a large degree on the quick repair of defects in the road. Patrol men are employed by some State highway departments whose duty is to patrol and patch approximately five miles of road. In other States and in many cities and towns, a repair gang is used consisting of several men, an auto truck, tools and materials for repair. The "gang" usually patrols thirty miles and upwards of roads.

The mainstay of both patrol and gang outfits on bituminous work is a cut-back binding material which is used cold, and yet quickly sets up with a good bond when mixed with stone. The coal-tar cut-backs have given most excellent results if only simple precautions are taken in using them. The size of stone should be graduated to suit the depth of the hole to be patched.

The large stone are mixed with sizes grading down to half or quarter inch and the remaining voids filled with sharp sand. Only enough bitumen is added to thoroughly coat the mineral particles after the batch has been thoroughly turned by hand labor with shovels, or better in a small concrete mixer. The batch is best seasoned before using, but is often used at once in plugging up the holes.

The fault most often developing in these cold-mixed patches is pushing out of the hole. This is almost always due to an excess of bitumen, but may also develop from an excess of fine material in the mix.

The success of cold patching has been so great that attempts have been made to extend the patches into real construction. Druid Hill Park of Baltimore has good stretches of this type.

The material has found favor for temporary repairs to all kinds of city pavements. In Philadelphia, the sheet asphalt pavement on Broad Street is patched thus during the winter, while the asphalt plant is idle. Some of the patches escaping the eye of the asphalt repair gang have endured the heavy traffic for a year or more. In other cities, even stone block and brick are maintained with cold patch. It is becoming the universal road specific indicated for all holes, breaks and minor defects.

Surface treatments, as has previously been observed, cannot make a worn-out or defective road satisfactory. A really worn-out and neglected macadam is a terrible thing to ride over in an



automobile, yet it may be like as not resurrected or rebuilt at a cost not too great. The old macadam States have solved the problem by using the old macadam as a base for a bituminous macadam pavement top. The old macadam is broken up, is smoothed, and also widened, if the road is too narrow. If the crust is too thin, new macadam stone are added and rolled till they lock. Then two gallons of refined tar cement to the square



Truck spraying on Refined Tar Binder, Penetration Method, Bituminous Macadam construction

yard are sprayed on best with an automotive sprayer. The success of the treatment lies in having a road locked, yet open enough to receive the bitumen into its pores, and in rolling and further closing the surface with fine stone and seal coats until a perfectly solid top is produced.

The operations are simple enough, and yet through lack of skill and through the choice of the stone and bitumen not suitable for the process, failures have resulted. The miles and miles of successful work, however, attest that the process is the most economical and satisfactory way of topping worn-out macadam and in building new macadam pavements to resist modern traffic conditions.

Refined tars used in road work are manufactured from the raw tars derived from the gas works and from the by-product coke-

oven plants. The tar is produced by the decomposition of bituminous coal and is removed from the gas in the process of purification.

In addition to the coal tars, a certain amount of water-gas tar is also used in the manufacture of road tars. Water-gas tar is of quite different origin from coal tar and is produced by the decomposition of certain petroleum oils which are used in the enrichment of water gas.



Harvard street, Cambridge, Mass. One of the earliest Penetration Method Bituminous Macadam roads constructed. Built in 1907

Tars vary greatly in their characteristics and it is necessary to blend them carefully in order to meet any proposed specification, and then to subject them to distillation in order to produce the tar desired for road work. The processes of manufacture have been so far perfected that it is possible to turn out materials of very uniform grade and excellently adapted to road purposes. Constant watch is kept through laboratory control in all parts of the manufacture and much research work is constantly going on to perfect the materials for the different uses to which they are put.



## CONCRETE HIGHWAYS

By THE PORTLAND CEMENT ASSOCIATION

**P**ORTLAND cement concrete is an artificial stone made by mixing together portland cement, a fine aggregate such as sand, a coarse aggregate of crushed stone, pebbles, slag or other such material, and water, and allowing the mass to harden.

The first records of total concrete pavement yardage was compiled in 1908. At that time there were 591,400 square yards of concrete pavement in the whole United States. Ten years later the total had increased to 113,555,000 square yards, an average construction of almost a million square yards a month for the period between 1908 and 1918. During 1921, the biggest year in the history of concrete construction, 62,000,000 square yards were laid, bringing the total of concrete pavements in the United States to over 262,000,000 square yards, equivalent to 22,489 miles of 18-foot concrete road. Seventy-nine per cent of the pavement mileage on which Federal-aid funds were used in the past five years was concrete.

This increase in popularity has been largely due to the fact that concrete pavement is so admirably fitted to carry automobile traffic. Its surface is so rigid that wheels do not depress it and the tractive effort required to pull vehicles over it is almost as low as that required on steel rails. This makes the gasoline consumption of vehicles using it very low. Concrete is easily given a very smooth surface, which it retains in all kinds of weather and temperatures, insuring easy riding; yet the moment there is any tendency to skid, tires grip it with a tenacity unequaled on any other type of hard surface. There is no disintegration due to atmospheric conditions, and well-laid concrete pavements show no signs of wear after years of use.

When concrete was first used for pavements few people knew much about it. As with any other construction material, the early builders learned much from their mistakes as well as from their successes and from laboratory experiments. The quality of the concrete road has been steadily improved. The knowledge of its fabrication has become more widespread, until today it is the best known, best understood, and most highly standardized of all our paving materials.

Recent investigations have dealt not so much with the manufacture of concrete itself as with the loads concrete pavements may be expected to carry successfully.

The U. S. Bureau of Public Roads in a series of tests to determine the load value of the pounding action of vehicles has established the fact that surface roughness is one of the greatest causes of road destruction. An obstruction one inch high, struck by a solid rubber-tired wheel traveling at 20 miles per hour, produced an impact on the pavement equal to  $7\frac{1}{2}$  times the actual load of the wheel. This gives added significance to the permanently even surface possible with concrete. The maximum impact of truck wheels equipped with pneumatic tires was only  $1\frac{3}{4}$  times the load. Cushion tires produced effects between those of solids and pneumatics, the exact amount depending upon their flexibility.



Passenger bus operated by the Motor Transit Co., on the Pomona Boulevard near El Monte, Calif.

The Bureau also tested the resistance of various types of pavement surfaces to impact by dropping onto them a weight designed to reproduce the impact of a truck wheel. Except for slabs less than 4 inches thick, concrete, inch for inch of depth, gave greater resistance than any other pavement tested.

Experimental roads were built during 1921 near Pittsburg, California, and Springfield, Illinois, of various widths and thickness of both plain and reinforced concrete. These roads will be destroyed by subjecting them to intensive truck traffic. Stations have been provided for observing the action of the slabs under loads and with varying subgrade moisture content. It is expected



the information obtained will many times repay the amounts spent for the investigations.

The California highway has already been tested to the destruction of several of the various types of slabs. Conclusions drawn from the tests have not yet been published, but maps showing the condition of each section have been sent out from time to time. These maps seem to indicate that a reduction in thickness of plain concrete slabs cannot be compensated for by the use of any reasonable amount of reinforcement (the plain slabs showing fewer cracks than slightly thinner reinforced slabs), and that additional



When roads are constructed one-half at a time as this one in Litchfield County, Conn., traffic need not be detoured during construction

strength is obtained by putting an inverted curb under the edge of the pavement.

Destruction of the Illinois road has not commenced, but studies of the effects of temperature and moisture upon slab and subgrade are being carried on. Chief Highway Engineer Clifford Older says the experiment has already made it possible to save the State \$1,500 per mile on concrete pavements.

Both test roads vindicate Mr. Older's contention that a longitudinal center joint is desirable.

#### Design.

The past year has brought forth some changes in design.

States which specify reinforcement have, in many cases, in-

creased the amount of steel used. Some other States which have not previously used reinforcement now include it in their specifications.

Several States are installing a joint down the center of pavements 18 or more feet wide. This eliminates longitudinal cracking, reduces the strain on the slab when the edges are not supported by the subgrade, and provides an accurate dividing line which keeps traffic on the proper side of the road. This feature will probably be more generally adopted in the future.



The National Road near Frederick, Md. Concrete shoulders built on each side of the existing bituminous macadam highway make travel safer and conserve the original investment in road construction

Arizona has adopted a pavement section three inches thicker at the edge than at the quarter points or center. It is recognized that the margins of any road pavement are its weakest points. If these edges can be made as strong as the center section, so that all parts of the slab can carry equal loads, the efficiency of the pavement will be doubled. The tests of the California experimental road, and the quality of the Arizona pavement, indicate that an increased thickness of concrete at the edge is a step in the right direction.

Experience indicates that the ideal width for two-track roads is 20 feet. This width reduces shoulder maintenance and it is claimed that the saving in maintenance cost makes the 20-foot pavement the economical width to build. Highway officials at the 1922 Good



Roads Show passed a resolution expressing their preference for the 20-foot width.

There are many communities which need paved highways, but which cannot finance the desired mileage of full-width pavement. If the roads to be paved carry a small amount of traffic, a half-width or "single-track" hard surface may be built. As this road will surely be widened at some later date, it should be built as the right or left half of a full-width pavement, with one edge at the center of the right of way and with the slope toward the outer



The Dixie Highway in Cook County, Ill., south of Chicago

edge. It should be either nine or ten feet wide, depending upon whether the standard full-width road is 18 or 20 feet.

Considerable opposition to half-width roads is sometimes expressed. This is because of the general dissatisfaction with pavements 12, 14 or 16 feet wide. Such widths were built to do something they would not do—carry two lines of traffic—and the dissatisfaction occurred because they would not fulfill their purpose. The 9- or 10-foot width would have done as well, at much less cost, and could have been widened when traffic demanded it.

Widening of the various types of macadam and gravel roads with border strips of concrete is one of the interesting developments of the year. The macadam may be in good condition and only require widening, or the edges may be so broken down as to

require replacement. The concrete strips act both as a wheelway and a curb to retain the macadam. Maryland builds the concrete strips 2 to 6 feet wide. In New York, single-track pavements 8 or 9 feet wide have been built on each side of the macadam.

*Thickness.*—There has been a slight increase in the thickness of concrete pavements in some States, to keep pace with the increasing heavy truck traffic. This has occurred in States where previously built slabs were below the average thickness of 6 or 7 inches at the edge and 8 or 9 inches in the center.



A part of the Maricopa County, Arizona, 300 mile county highway system. Funds for paving these roads are provided by two bond issues totaling \$8,500,000

*Crown.*—Pavements are crowned only so that water falling upon them will flow to the sides. The less the crown the better for traffic. Concrete roads 18 or 20 feet wide are usually given a crown of 1 inch.

*Super-elevations.*—When an automobile turns a curve at high speed the tendency is to slide off the pavement on the outside of the curve. To avoid such accidents and to keep motorists from driving on the left side of the road, through fear of skidding, the whole pavement is sloped toward the inside of the curve. The amount of this slope depends upon the degree of the curve. A slope of 1 inch per foot is not excessive on curves of 150 feet or less radius, and produces an easy-riding pavement. On curves



of 150 to 500 feet radius,  $\frac{1}{2}$  to  $\frac{3}{4}$  inch slope per foot of width is customary. Curves flatter than 500 feet radius are built with the ordinary crown.

*Widening at Turns.*—The tendency of autoists is to drive close to the inside edge of pavements at turns, even though that brings them on the wrong side of the road. To reduce the danger of collision at such places pavements are often widened along the inside edge on curves having a radius of less than 500 feet. It is also advisable to widen the shoulder, and build the ditch farther from the pavement edge, on the outside of sharp curves, so that



The elimination of grade crossings is one of the features in modern highway construction. Dauphin-Clark's Ferry Road, Route No. 1, Pennsylvania Highway System

those who try to make the turn at too great speed will be protected as much as possible from serious accident.

An added safety feature at curves is the flattening of the sides of cuts and the removal of other obstructions, so that drivers can see ahead for 500 feet.

*Aggregates and Aggregate Handling Equipment.*—Both "home-made" and patented bins have been very successful in diminishing the cost of handling aggregates. Equipped with measuring boxes, spaced to come exactly over each compartment in truck or industrial train, they have reduced the loading time to a matter of seconds and the labor of loading to pulling two or three levers. Their greatest advantage, however, has been in insuring clean

aggregates proportioned with an accuracy which insures a pavement every square foot of which is alike, and will wear evenly.

The use of local aggregates deficient in coarse material has proved economical in many localities. A cubic yard of this concrete, proportioned as indicated in Prof. Abrams' tables, or by some similar method, has been found cheaper than a cubic yard made in the usual proportions, with coarse aggregate shipped considerable distances, and is easier to place and finish. Tests of prepared cylinders or cores, bored from the finished road, indicate a crushing strength at least equal to that of concrete made with coarser aggregates.

While many specifications require the separation of fine and coarse aggregates and expressly forbid the use of "bank" or "pit run" material, Iowa has been making good concrete from unscreened, clean gravel. The success of such a procedure depends upon accurate knowledge of the grading of the pit-run gravel. This is obtained by hourly screen tests of the material going into the mixer. Proportions are varied as often as is required to produce a concrete of the specified strength. The cost of this close inspection is reported to be less than the cost of screening and re-proportioning all aggregates.

The necessity for laboratory control of concrete road construction is well recognized by the State highway departments. Both laboratory and field tests are the rule for all materials, and careful inspection of construction operations is prevalent.

The colorimetric test for organic impurities in fine aggregate is being more generally adopted.

Most State specifications include some test for the grading of sand, usually that 100 per cent shall pass a  $\frac{1}{4}$ -inch screen, not more than 5 per cent shall pass a number 100 screen, and not more than 25 or 30 per cent shall pass a number 50 screen. The maximum amount of clay or silt allowed is usually 3 per cent by weight.

Coarse aggregate sizes are not often specified between the maximum and minimum. With the increase in thickness of the slab the maximum allowable size of crushed rock has been increased, some specifications admitting materials which pass a 3-inch square opening.

The whole subject of aggregate sizes and their relation to the strength of concrete has been investigated by Prof. D. A. Abrams, of the Lewis Institute, Chicago. The results of this investigation have been published and indicate that almost any sized aggregates may be combined to make concrete of the strength required for road work, it only being necessary to use the right amount of cement and the correct proportions of sand and coarser material. The more general use of Prof. Abrams' tables is commended, for they permit the use of unusual sizes of local aggregates and may effect a considerable saving to a community.



### Construction.

The year 1921 was marked by the largest single road contract ever awarded at one time—140 miles of concrete highway in Maricopa County, Arizona. Though some States continue to let contracts for comparatively short sections, the trend is toward larger contracts, handled by larger, better equipped organizations. It is believed that the larger organizations should be able to build both better and cheaper pavements, through better superintendence, the use of labor-saving machinery, retention of an experienced organization, and other savings of quantity production. There seems,



Coleman Du Pont Boulevard in Sussex County, Delaware

however, some danger of over-equipment and consequent excessive "overhead" charges.

Paving mixers have grown in size until the latest is a leviathan with a rated capacity of one cubic yard of mixed concrete. This manufacturing plant is pulled along the subgrade by a crane, which also lifts the batch boxer from the industrial railway car or truck to a position over the hopper of the mixer. From this position the proportioned batch is dropped directly into the drum. The first cost of such an outfit is high, but some consistently good records have been reported.

The last construction season saw the very general adoption of central proportioning and central mixing plants. The saving of

materials formerly stored along the subgrade and the opportunity to handle all materials with machinery has convinced the contractor, and the better subgrade and cleaner aggregates have convinced the engineer, that these methods of handling construction are superior to the older method of storing materials on the subgrade and transferring them to the mixerskip in wheelbarrows. Many State specifications now prohibit storing materials on the subgrade.

The U. S. Bureau of Public Roads made tests to determine the length of time mixed concrete could be hauled without impairing its strength. Results indicated that no reduction in strength occurred up to three hours after mixing and that if the concrete was not too hard to place and finish it would be as strong as concrete placed immediately after it was mixed.

Night work was another of last season's developments. Reports indicate that the night shift not only builds as perfect pavement as the day shift, but usually is able to lay a larger yardage, due to cooler temperature and less outside interference. The chance to double the season's production without increasing the equipment investment will not be lost on paving contractors. The only additional equipment required is some form of lighting system. Storage batteries, a generator and electric lights can be installed on the mixer to produce sufficient illumination for all operations except form setting and the final finishing. Portable lights are used for each of these latter operations.

Mixing has grown to be more of a mechanical operation since both the amount of water and the mixing time are controlled by automatic mechanical devices. Mixing time is quite generally one minute, with a few States requiring a minute and a half.

The dry mix has become the rule, the wet mix the exception. This is partly due to the wide publicity given the reduction in strength caused by a slight excess of water, but the finishing machine, requiring, as it does, a dry mix for satisfactory operation and relieving laborers of the arduous work of spreading "sticky" concrete, deserves a great deal of credit.

The truncated cone or "slump" test is the only field method yet devised for a reasonably accurate measure of concrete consistency. Though there may be a slight difference in the slump of round and sharp-cornered aggregates, it is nevertheless a more definite measure of consistency than is possible by any description of the appearance of the concrete. While many States specify a "slump-test," it is believed it should be more generally adopted.

*Finishing.*—The government impact tests, previously referred to, emphasize the need of careful finishing. When an unevenness in the surface of only  $\frac{1}{4}$  of an inch can produce an impact pressure of 20,000 pounds from one wheel of a loaded 5-ton truck, it is apparent that good surface finish is of paramount importance.



Poor workmanship in striking off and finishing, especially at the joints, is the most frequent cause of unevenness. It is eliminated by careful, thorough attention to details.

Before the final belting the concrete on both sides of expansion joints should be checked with a 10-foot straight-edge. Any variation from the true surface should be corrected. The surface between expansion joints should also be checked with a 10-foot straight-edge, laid parallel to the pavement center line. Any inequalities should be corrected before the concrete has begun to harden.

Either hand or machine methods can produce a properly finished road. Both require intelligent direction. In hand finishing the concrete is spread with shovels and "struck off" with a hand templet cut to give the road the required crown. This templet should be so heavy it will not "ride" over the piled-up concrete, leaving ridges, and so rigid it will hold a true shape under all conditions of use. From ten to twenty pounds per foot is the weight most often specified for hand templets. Some patented templets are now made to span pavements 40 feet wide.

After the concrete is "struck off" it is further smoothed and compacted with a hollow steel roller about 6 feet long, 8 to 12 inches in diameter, and weighing about one pound for each inch of length. The roller is operated by a long handle, if the road is not over 20 feet wide, and by ropes attached to the bail on wider streets. Rolling is continued at intervals of about 15 minutes, until no water is squeezed from the concrete, the specifications usually requiring at least three separate rollings.

When the rolling is completed the surface is finally finished with a belt of canvas, rubber or wood. The belt is about two feet wider than the slab and is laid flat on the concrete surface. It is operated by two men who give it a sawing motion and the surface is covered at least twice. For the first belting the cross-strokes are long, and the advance with each stroke only a few inches. The second belting is given just after the water glaze or sheen disappears, the cross-strokes are only a few inches, and the advance with each stroke is much greater than with the first belting. Because it will lie flat, a thin board has sometimes been substituted for the canvas or rubber belt and is reported very satisfactory. The fabric belt has also been fastened to a light frame or "bow" which holds it flat and gives a better surface than can be obtained with the free belt.

*Finishing Machine.*—Several machines for striking off, tamping, and belting the concrete for concrete roads have been perfected. Given solid forms and an operator who is more than just a gas-engine fixer, finishing machines will produce concrete pavements equal, if not superior, to hand-finished pavements. One State requires their use; one allows a saving of 1/10 barrel of cement per cubic yard of concrete when finishing machines are

used. They are not, however, well adapted to steep grades, or to roads having many turns which are given extra width.

*Joints.*—There are two kinds of joints—expansion and contraction—and they run in two directions—parallel, and at right angles to the center line.

Expansion joints are made by filling a space between concrete slabs with an elastic material which will compress as the slabs expand. They are usually transverse, and spaced at definite intervals. An expansion joint should always be left between the pavement and any rigid structure against which it might otherwise exert pressure.

It is well known that a rise in temperature or an increase in moisture content will cause concrete to expand. It is also known that pressure will squeeze concrete into a smaller space. If there is no room for expansion the pressure developed will produce a corresponding contraction and the slab will not move. The pressure produced will not exceed the normal crushing strength of concrete, so expansion joints are not a necessity. However, the possibility that a transverse contraction crack is not at right angles to the surface, and that extreme pressure will cause one section of the slab to rise, or may even shatter the joint, makes the use of frequent expansion joints advisable.

For contraction or construction joints the concrete is not separated by any elastic material. The joint may be made by installing a separator of sheet metal or building paper, or fresh concrete may be placed directly against concrete which has hardened. This type of joint is seldom used except when concreting is stopped at noon and night, or for longitudinal center joints. They must be at right angles to the pavement surface and the two slabs should be connected by dowels of short steel rods to prevent independent vertical movement.

*Forms.*—Both wood and steel side forms are in common use. Most contractors prefer the steel sections and some States require them except on curves. In the northwest Pacific States the wood forms are left in place to serve as edging.

Finishing machines use the side forms as a track. If the track is depressed by the weight of the machine the concrete surface is depressed an equal amount. For that reason it is very important that forms be set so they will remain true to line and grade.

Steel forms make a better track than wood forms because they have an interlocking joint which makes all parts of the track equally rigid. Steel forms should be strong enough to carry the finishing or subgrading machines in use without bending and should have a broad base and sufficient provision for staking.

Wooden forms should be capped with an angle iron, if they are to serve as a track. This cap should be put on after the forms are in place and should extend across all joints.



*Curing.*—The importance of properly curing concrete roads has been generally recognized. All slab specifications require that in some way the concrete be kept moist during the curing period. This is generally done by covering the concrete with a layer of earth, straw or hay, which is kept moistened for a period of ten days to two weeks. A covering of calcium chloride has been used for the same purpose.

The best method of curing is called "ponding." Small earth dams are made alongside the concrete. Cross-dams are put in at intervals, depending upon the grade of the pavement. The enclosed space is filled with water which should cover the concrete to a depth of 2 or 3 inches. This method can be advantageously used where grades do not exceed 4 per cent.

Under the most favorable conditions for hardening, traffic should be kept from the pavement at least 14 days. In many States the minimum time the pavement is kept "closed" is 21 days, and some States require a 30-day curing period.

### **Maintenance.**

The maintenance required on concrete roads divides itself, as on all roads, into two distinct parts; the work which is required to be done on the shoulders, ditches and other drainage structures, and that which is required to be done on the pavement proper. Only the latter feature will be here considered.

Prompt maintenance should be the rule on concrete roads, as with all types of roads. Cracks in concrete roads occasion no inconvenience whatever to traffic, and traffic will not injure the road at such a place if the crack is filled with tar or asphalt and covered with sand. The bituminous material is poured into the crack in sufficient quantity just to flush the edges. There have been developed portable outfits mounted on small trucks which make it possible for a crew of two or three men, including the driver of the truck, to operate most efficiently.

Where it is necessary to cut through a concrete pavement for any reason, it can be replaced so that it is almost impossible to tell where the repaired portion is. It has been found that the best repairs are made by using a very stiff mixture and ramming the concrete thoroughly into place. The edges of the cut should be shaped so as to be practically vertical for a depth of 2 to 3 inches from the surface. The repaired surface may be covered with planks over which is thrown a layer of moist earth, so that the pavement may be immediately used by traffic with but slight inconvenience, in case the cut occurs at such a point or is of such an extent that that portion of the highway cannot be entirely blocked temporarily.

## BRICK ROADS

By WILL P. BLAIR

*Vice President of the National Paving Brick Manufacturers' Association*

VITRIFIED brick for use as a wearing surface on streets and roads, in the United States, now cover a period slightly exceeding forty years. During this time they have been subjected to almost every conceivable idea of placement in the roadway for that purpose. They also have been made to bear the severest test of travel. The processes of manufacture have undergone a like variation throughout all the steps taken to produce a brick of present-day quality.

Though vitrified paving brick are manufactured from shales and fireclays, each differing in composition by subjecting the different clays to various ascertained treatments in process of manufacture, a remarkable uniformity of quality meeting the requirements for use as a paving material, has been attained. With no restraint and little endeavor on the part of the manufacturer to conform to a uniformity of sizes, it was recently ascertained that there was offered to the market a great variety of sizes—sixty-six in number. A conference was called by Secretary Hoover of the manufacturers and a large number of engineering organizations. This conference, taking into account the saving to the manufacturer and economy to the user, eliminated as an unnecessary excess, all such sizes but eleven in number, namely:

*Plain Wire Cut Brick:*  
(Vertical Fibre Lugless)  
3 " x 4 " x 8½"  
3½" x 4 " x 8½"

*Repressed Lug Brick:*  
3½" x 3½" x 8½"  
3½" x 4 " x 8½"

*Vertical Fibre Lug Brick:*  
4 " x 3 " x 8½"  
4 " x 3½" x 8½"

*Wire Cut-Lug Brick:*  
(Dunn)  
3½" x 3 " x 8½"  
3½" x 3½" x 8½"  
3½" x 4 " x 8½"

*Hillside Lug Brick:*  
(Dunn)  
3½" x 4 " x 8½"

*Hillside Lug Brick:*  
(Repressed)  
3½" x 4 " x 8½"

Of the foregoing eleven sizes it is now well understood that but two sizes embrace ninety-five per cent of vitrified brick used today, namely:

3 " x 4 " x 8½"      3½" x 4 " x 8½"



By the use of these two sizes, three several depths of brick wearing surfaces are built.

The  $3'' \times 4'' \times 8\frac{1}{2}''$  is often laid on its side, exposing a  $4'' \times 8\frac{1}{2}''$  surface, making the depth three inches.

The  $3\frac{1}{2}'' \times 4'' \times 8\frac{1}{2}''$  laid on its side, making a wearing depth of  $3''\frac{1}{2}$ .

The  $3\frac{1}{2}'' \times 4'' \times 8\frac{1}{2}''$  laid on edge, making the depth of the wearing surface 4".

These three depths for brick wearing surfaces are in common use today, and constitute at least ninety per cent of the brick wearing surfaces.

The general process of manufacturing vitrified brick, regardless of certain variations required by the different clays, is quite common in all the plants. The raw materials are crushed and ground dry in large revolving pans under heavy rolls, called "mullers." This material is screened to remove pieces of too large size, and is then conveyed to a pug mill, wherein water is applied, forming a stiff mud mixture. This mud is fed continuously into a brick machine, where it is forced by an auger through a die, whence it emerges as a fairly hard, stiff mud bar of rectangular section, which is cut mechanically into bricks. This bar of clay may be approximately  $3 \times 4$  inches in section, in which case it is cut about every  $8\frac{1}{2}$  inches, forming "end-cut" bricks, or it may be approximately  $4 \times 8\frac{1}{2}$  inches in section and cut every 3 inches, forming "side-cut" bricks, in either case producing a brick in size  $3 \times 4 \times 8\frac{1}{2}$  inches. In like manner a  $3\frac{1}{2} \times 4 \times 8\frac{1}{2}$  inch brick is produced. These bricks are sometimes submitted to a reshaping process before drying, in which case they are called "repressed" bricks, and sometimes they are dried as they are finished by the brick machine, in which case they are called "wire-cut" brick.

According to the process of manufacture, one side of a paving brick may have two or four lugs, which are small projections from the surface of the bricks. These projections serve to keep the adjacent faces slightly apart when the bricks are forced into contact during the paving operations. These projections extend  $\frac{1}{8}$  to  $\frac{1}{4}$  inch from the side or face. In one class of side-cut bricks the cutting is done by wires, which are moved across the bar of clay so as to produce the lugs needed on one side of the brick. These are called "wire-cut-lug" bricks. When the clay column is cut straight through, the brick are termed "wire-cut."

"Hillside" bricks are made for use on grades of 5 per cent or more. They have one or more grooves cut the full length of the bricks, along their edges, in the case of bricks to be laid in the usual manner, or two grooves cut transversely in the case of bricks to be laid parallel with the curb. These grooves are about

$\frac{3}{8}$  inch deep and are intended to prevent slipping of horses or automobiles. Bricks with beveled edges are used for grades, notably on the carriage ramps of the Pennsylvania Terminal in New York, where the travel is very heavy and quite generally on grades exceeding five per cent, and almost universally on the grades in the mountain regions of Pennsylvania.

About twelve years ago the National Paving Brick Manufacturers' Association,<sup>1</sup> through a long series of testing, involving the expenditure of many thousands of dollars, attained a standardization of the rattler, including a method of procedure in its use for testing the quality of paving brick. Specifications of this rattler and its use as promulgated by this Association were subsequently approved and adopted by the American Society for Testing Materials, for testing paving brick. This rattler and its use has since become a universal equipment at the various paving brick manufacturing plants throughout the country. Likewise it is relied upon universally for measuring the quality of brick as contracted for use by various official authorities of cities and states. It has proven wonderfully advantageous to the manufacturer by its use at the manufacturing plants by continually checking the quality as the brick are manufactured from day to day. Its use provides an efficient protection to the public in maintaining the quality of brick contracted for. For these purposes not only its adequacy but its convenience, as well as its reliability, are universally conceded by all having an intimate experience in the manufacture and use of paving brick.

### Curbs

Curbs are required along the sides at the edges of the city streets as a part of the gutter provision for the flow of water and as a wall to support the lawn on sidewalks at its grade elevation. They form a part of the finish which contributes to the tasteful appearance of the street.

In the construction of country roads, experience has shown that where monolithic or semi-monolithic construction is used, by laying the brick in green mortar or mixtures of sand and cement and filling the joints with a cement filler, curbs are not needed and are a useless expense.

Experience has also demonstrated that curbs are not needed where asphalt fillers are used. The practice of making the curb an integral part of the foundation is more harmful than beneficial. A trough is formed which holds the water, permitting it to subside

<sup>1</sup> From whom complete Specifications for the Construction of Brick Streets and Roads, as well as complete Specifications for the Construction and use of the Rattler, may be obtained.



into every chance crevice and opening in or underneath the pavement, instead of the needful provision for an unimpeded flow from off and away from the pavement.

Experience has further shown that a curb in dependent of the base and set up against the pavement performs its supposed function with but little effect. The frost raises the curb out of place, or with a moistened condition outside the curb it is easily pushed away, leaving the base without any embankment support whatever.



Only one thing wrong with this Brick road. Mr. Blair says that "Curbs are not needed and are a useless expense"

A gravel, broken stone or slag embankment or shoulder which would be subject to compaction by the occasional overlapping of vehicular wheels has proven a far better protection. A still better protection is a berm penetrated with a bituminous material which would allow readjustment of a possible displacement. Present day travel demands that roadways be paved a much greater width than formerly and where they are paved of sufficient width to accommodate the traffic in safety it is noted that travel rarely ever "gets off" the paved portion.

### The Subgrade

The injury which results from the saturation of the subgrade with water is so great that it would seem that greater efforts to relieve the subgrade of moisture should be undertaken, regardless of the character of the wearing surface. Research into this problem has developed accurately a knowledge of conditions from

this source of which heretofore our sole reliance as to what might be done has been based upon a mere guess. We now know something of the percentage of water by volume which a cubic foot of certain soils will hold. We know something of the expansive force due to moisture alone. We know the extraordinary injurious force exerted if the moisture content is subjected to low temperature. It is easy to see from the intermittent support which follows contraction and expansion of the subgrade with the water ranging from 0 to 40 per cent that destruction of the wearing surface will result.

The most vital need in all road building is to render such drainage treatment to the subgrade as will reduce these extreme conditions to a uniform stabilization and thereby influence a uniform support on the part of the subgrade for sustaining travel and impact upon the surface.

We do know that soils composed largely of coarse material, such as gravel, rock or stone, accelerates drainage and affords a uniform bearing. It is well, therefore, to take lessons from conditions which nature has afforded of this character in many parts of the country. Brick roads built upon such subgrades, or where broken stone or gravel has been artificially supplied, that injury to the brick wearing surface has been reduced to a minimum and the brick surfaces have endured almost indefinitely without repairs. It has been found that in placing the wearing surface upon such a foundation, whether naturally found or artificially provided, extreme contraction and expansion is absent and that a brick wearing surface can be built under such conditions as will create an adjustability so that the slight contraction and expansion of the subgrade can be and is conformed to.

This ideal condition for durability is attained after the well drained subgrade is provided with natural or artificial foundation, upon which the brick are placed and the joints filled with a character and quality of asphalt filler, which in its refinement does not permit it to flow under the influences of the ordinary summer heat nor does it congeal when subjected to low temperature. A brick road thus constructed is not injured by the natural destructive agencies that would otherwise injure it if the brick wearing surface was made rigid in character, which at one time met with much approval but in long years of experience has demonstrated that these natural agencies will superinduce breaks and cracks, which are now avoided by the construction above outlined.

It is readily observed that the grade alignment of gravel and stone roads which are properly paved suffers but little impairment from injury due to superstructure conditions, though possessing but little slab strength. If, therefore, there is added to



the construction of a properly prepared roadbed a compacted gravel, stone or slag base, the protection of an impervious wearing surface of vitrified brick, the road improvement will be one of such durable and satisfactory character that comparable with its cost the height of economy in road improvement will be attained.

Railroads depend for economy on a resilient base, for the greater the weight and force of attack the greater the injury to the rigid resistance. Benefitting from this experience, a stable bed of rolled stone is doubtless the most scientific support to a wearing surface. But where a concrete base is used and thought necessary as a supplementary support to the wearing surface and



Laying Brick on one inch Sand Cushion which covers a Concrete Base

to aid in distributing the load to an area larger than the contact wheel base of the traffic, the resilient advantage may be maintained in part and the base protected from destruction of the traffic impact by spreading over the base a slight sand cushion of not exceeding an inch in thickness upon which to lay the brick and filling the joints with an asphalt filler with a high melting point. The one-inch sand cushion not only protects the concrete base from the shock of traffic, but is a buffer to the wearing course of brick against the upper thrust of the expensive force from below.

This cushion, together with the elastic nature of an asphalt filler, will also permit the slight readjustment to original placement of any disturbed portions of the wearing surface, brought on by causes which would result in very considerable injury to other characters of construction.

If the autoist could but be impressed with the economic value of the principles of road building as outlined herein, their influence for their application would reflect a saving of maintenance expenditures amounting to millions annually and the country would realize that there is such a thing as a road of great durability.

A correct understanding as to the natural agencies which exert injury to roads is a fundamental requirement. Without such qualification one is scarcely fitted to pass judgment as to what should be done or what should not be done in the building of any road. Provisions must be made in each case to prevent destruction from such causes. Flood, moisture, climatic conditions and the varied influences which arise from them must be given proper consideration. It is not too much to say more repairs are due to an utter disregard of these influences and neglect to provide against them than the impairment of roads by the actual traffic upon them. Traffic injury to the brick wearing surface is but slight indeed, unless that surface is first placed at a disadvantage by neglect of the natural causes.

A significant fact that may make what is here stated more impressive is that where proper provision is made and complied with in the construction of brick pavements, covering existing conditions with a proper installation of the pavement, regardless of age or volume of traffic, such pavements have not suffered any appreciable wear, many have not been subject to any repair whatever, and others have needed only the slightest repair.

The details necessary to realize the advantages of these suggestions and the information given particularly belong to the specifications, which must differ in part in the improvement of each road. Conditions are found which must be dealt with as they exist. No two road conditions are alike. A universal rule, however, in complying with every specification which is made is that no detail shall be neglected or carelessly executed.



## GRANITE BLOCK PAVEMENTS

By THE GRANITE BLOCK PAVING MANUFACTURERS' ASSOCIATION

*The Stone.*—Granite is an igneous rock of crystalline structure composed of interlocking grains of quartz, feldspar and mica, or hornblende. In structure the granites vary considerably. Those having fine-grained structures are called cryptocrystalline and those having coarse-grained structures are called holocrystalline. This difference in structure is due largely to the rate of cooling of the magma that formed the granite. If the molten rock cooled slowly the grains are larger than if it cooled rapidly, but the rock has exactly the same composition. The color varies with the pigment contained in the feldspars. It is often possible to find a paving block of different grain and color at different ends of the block, due to different pigments and different rates of cooling. Normally, granite is a massive rock without foliation or banding. When it takes on a banded structure it is called granite gneiss.

*Occurrence.*—Granite occurs in large masses almost entirely among the older rocks in the United States. Its wide distribution, as shown by the map above, makes it available by short hauls or shipments for use in every large city in the United States.

*Texture.*—There are three grades of texture in granite:

1. Coarse-grained, in which the feldspar grains measure over one-half inch to one-fourth inch in diameter.
2. Medium-grained, in which the feldspar grains measure from one-half inch to one-fourth inch in diameter.
3. Fine-grained, in which the feldspar grains measure less than one-fourth inch in diameter.

*Main Constituents.*—The main constituents of granite are quartz and feldspar. Both are harder than steel and are very nearly indestructible. Hardness is an important property of all granites and is defined as the resistance of a mineral to abrasion or scratching. It is usually explained by comparing with Moh's scale, which comprises ten minerals arranged in the order of increasing hardness, as follows:

- |             |             |
|-------------|-------------|
| 1. Talc     | 6. Feldspar |
| 2. Gypsum   | 7. Quartz   |
| 3. Calcite  | 8. Topaz    |
| 4. Fluorite | 9. Corundum |
| 5. Apatite  | 10. Diamond |

Feldspar, the largest portion of the granite mineral content, is a group of silicates of alumina, potash, soda or lime or their mix-

tures. The crystals may be recognized as colored, formless grains, or as crystals with a good cleavage in two directions at 90 degrees from each other in the orthoclase and 86 degrees in the plagioclase series.

Quartz generally occurs in granite in shapeless grains or masses. It is usually colorless and glassy-looking. It has no cleavage and



A Granite Quarry

can be told by its conchoidal fracture. It is insoluble even in acid and it is very resistant to weathering processes, being altered chiefly by disintegration, from physical reasons rather than by decomposition from chemical forces.

Mica is also a group name, the most frequently encountered being muscovite (potash mica), and biotite (iron magnesia mica). Muscovite may be either colorless white, gray or green. Biotite is usually brown, black or dark green in color. Mica has a very perfect basal cleavage and splits into very thin, tough and flexible sheets.



The hornblende group or the amphiboles have long and bladed crystals with a highly developed cleavage parallel to the prism faces. The color varies with the amount of iron from white to black, but usually is a dark green or whitish green color. It has two cleavages at an angle of about 124 degrees.

*Joints and Planes of Cleavage.*—But for the presence of planes of mechanical weakness along which the stone can be split, it would be almost an impossibility to quarry it economically. Some of these planes of weakness are invisible, while others are actual splits or joints that divide one mass of granite from another. These joints or invisible cracks are due both to the cleavage of the constituent minerals and to contraction breaks made when the



Splitting and Cutting to Size

mass cooled. Granite breaks easier in some directions than in others. The plane of easiest fracture is called the rift. The next easiest is called the grain, and the hardest way is called the cut-off. These three planes are at right angles to each other and their presence makes it possible to split out the rectangular blocks used for paving by simply subdividing stones cut to dimension.

*Quarrying.*—In most quarries the granite lies in nearly horizontal sheets with natural bed seams. There are quarries that are monoliths, and seams must be developed in these quarries by the

successive explosions of small charges of black powder or by the use of compressed air or steam.

In the developing of a quarry the first step is to explore the surface to determine the extent of the quarry and also the presence of headings, dikes or veins. Core drilling reveals the thickness of the sheets and the quality of the granite.

The quarry is stripped of all overlying earth or rock and a face is developed. Blocks of any size can then be quarried by successive drilling and splitting with plugs and feathers.

These large blocks are then resplit into smaller blocks about 36 inches wide and 40 inches deep, and with random lengths. This is called dimension stone and when it is split up by the paving cutter will make blocks from 4 to 4½ inches wide and 5 inches deep. The larger slabs are delivered to the paving cutter in his berth. He has pneumatic tools and by repeated drilling and wedging he breaks the block down to an eight-block size. This is divided into a four-block slab and then drilling is discontinued. The block is lined on the back and a sharp blow of the hammer on the face causes it to break on the line until all the blocks are made. The blocks are then trimmed with a reel and are ready for use.

It has been seen that no stress has been exerted on any part of the block except just where the breaks were intentionally made, consequently there has been no shattering of the finished block during its manufacture. Great care should be exerted by engineers to whom blocks are delivered to see that the blocks are not thrown or dropped from a height, as this not only injures the stability of the block but also breaks off the corners and makes it difficult to get the close joint so sought after by the engineer.

*Size of Blocks.*—There are standard sizes that are made by the paving cutters.

THE STANDARD PAVING BLOCKS.

Trade Name of Block	Length		Width		Depth	
	From	To	From	To	From	To
Five inch.....	8"	12"	3½"	4½"	4¾"	5¼"
Four inch.....	7"	11"	4"	4½"	4"	4½"
Resurfacing.....	7"	11"	3¾"	4¼"	3½"	4"
Hassam Block...	6"	12"	3½"	4½"	4"	4½"
Manhattan.....	6"	10"	3½"	4½"	4¾"	5¼"

The five-inch block is now the United States standard granite block size developed by the coöperative effort of the paving engineers of the nation and the manufacturers. It is the heavy-traffic standard and any variations from this type and size are special sizes and, while they have no added benefits, cost more than the standard to make.

The four-inch and the resurfacing blocks have been developed to meet the demand for a granite block slightly shallower than the



standard, which could be used to replace worn-out pavements of other types where the concrete base still was in good condition. The four-inch types and Hassam are in very common use, but the resurfacing block is harder to make and is a special block not carried in stock by the manufacturers.

*Tests.*—For paving granite there is only one test required; *i. e.*, the French coefficient of wear or abrasion test. The present standard test requires that a sample of rock for the abrasion test shall weigh within 10 grams of 5,000 grams and shall be composed of 50 pieces of freshly broken stone of as nearly the same size as possible. While no reference is made to the shape of the pieces, the assumption has always been that cubical fragments should be prepared. These are tested in a cylinder so mounted on a frame that the axis of rotation of the cylinder is inclined at 30 degrees with the axis of the cylinder itself. The fragments of stone forming the charge are thrown from end to end of the cylinder twice during each revolution, causing them to strike each other and the sides and ends of the cylinder. The charge is carefully weighed before it is put into the cylinder and after 10,000 revolutions the resulting material is screened through a 1/16-inch screen. The material retained on the screen is weighed and the percentage of wear determined. The French coefficient of wear is 40 divided by the per cent of wear. The American Society for Municipal Improvements require for heavy traffic a minimum French coefficient of wear of 11 and for medium-heavy traffic a French coefficient of wear of 8. For heavy traffic a toughness of 9 and for medium-heavy traffic a toughness of 7 are specified.

The toughness test is made by subjecting a cylinder of the stone about 1 inch in diameter and 1 inch tall to repeated blows of a 4½-pound drop hammer which increases the height of its fall two-fifths of an inch after each blow. The height in centimeters (or two-fifths inches) of the fall or blow at the failure of the specimen is called the toughness. These two tests give some idea of whether the stone will wear well, but the actual service tests under travel in the streets of our big cities are the safest guide. Many attempts have been made to devise an accelerated wear test, the best known of which are the test ring at Teddington, England, and the Juggernaut at Washington, D. C.

*Construction—The Concrete Base.*—Upon a carefully prepared subgrade from which all soggy material has been removed and replaced with good gravel, a concrete base of 1-3-6 mixture is placed. This base is of not over 6 inches in depth and should be of machine-mixed concrete. The mixer should be of the batch type with boom and bucket or revolving-tube discharge. The consistency of the mixture should be such that it will flatten out itself and quake when deposited, but it should not be so liquid that it will

flow. The subgrade should be lightly sprinkled with water and then the concrete spread to the required depth. Concrete should not be placed on a frozen base nor in freezing weather unless the aggregate and mixing water are heated.

The foundation is crowned the same as the finished street. The crown is the difference in height between the grade of the center and the grade at the curb line of the street. Numerous formulæ have been derived by which the amount of crown may be determined. The usual crowns are one inch to each 4 feet



Proper Method of Laying

of width, distributed as follows: Drop one-eighth of the total crown one-fourth of the way from the center of the street to the curb. This point is called the mid-quarter point of the crown. Drop one-third of the total crown at the quarter point or half-way from the center to the curb. Drop five-eighths of the total crown at the mid-quarter point nearest the curb.

Nearly every city has its own crown formula and they are very easily laid out. If the street has railway tracks on it, the crown is the difference between the elevation at the rails nearest the curb and the curb, and is laid out between these points as if the rail were the center of the roadway. The crown is affected by the grade of the street.



It is necessary to give the roadway a crown in order to have the water that falls on the roadway find its way into the gutters.

*The Sand Cushion.*—As there is a variation in the depths of granite blocks, there must be spread over the concrete base a cushion of some material in which to pave the blocks. This cushion not only gives the blocks a firm bedding, but also is believed to give the pavement some resiliency. In present practice not over one inch of sand is specified. The thinnest layer of cushion which allows smooth paving and firm bedding by ramming is the best.

*The Mortar Cushion.*—It was found that in paving blocks on a sand cushion the sideways motion used by the pavers in laying the block sometimes caused the joint to become half filled at the bottom with sand. This sand prevented the grout from going down to the bottom of the blocks and sometimes causes the crushing of the heads of the blocks from unequal expansion strains. It was thought advisable, therefore, to specify a sand-cement mixture of one part of cement to three parts of sand thoroughly mixed when dry, on which the blocks were to be laid. Then if the joint was partly filled as soon as the mortar cushion was wet by the grout it set up at the bottom of the block. Its use on hills where the sand cushion might be jarred downhill is also common. There appears to be very little value in the sand-cement cushion when an asphaltic filler is used.

*The Paving.*—The blocks should be laid at right angles to the curb line, unless for some good reason the engineer should specify they be laid at an angle. The blocks must be laid in courses of even width and all joints should be broken so as to lap the block in the next row at least three inches. The blocks should be paved so the joints should not be less than three-eighths of an inch wide and not more than five-eighths inch.

*The Ramming.*—The success of a granite pavement depends greatly on the careful ramming. Each block should be struck by the rammersman and rammed to a solid bed. If this causes the block to sink below the surface line of the street, it should be taken up with paving tongs, more cushion material put in, the block put back and again solidly rammed to a firm bed. Do not try to roll a granite pavement. There is only one way to ram it correctly and that is with a skillful rammersman. The blocks should be struck at about the center and restruck until a firm bed is secured. At least one rammersman for each three pavers should be specified.

*Filling the Joints.*—The proper filling of the joints in a granite block pavement is the most important step in the whole construction. The joint filler keeps the block stable, waterproofs the surface and preserves the edges of the blocks so they will not become worn or cobbled by traffic.

*Portland Cement Filler.*—After the blocks have been thoroughly rammed to a finished surface, the blocks are lightly sprinkled with water and a grout filler, composed of one part of cement and one part of sand mixed with clean water in a mechanical mixer, is poured into the joints until they are full and surplus grout appears on the surface. The grout should be well broomed into the joints and the operation repeated as the grout settles until all the joints are permanently filled even with the tops of the blocks. No gravel is used in the joints in the latest specifications. After the grouting has been completed, barriers must be erected and all traffic kept off the street for ten days, because if the bond between the stone and the grout is broken it never will mend with a grout joint.

*Bituminous Fillers.*—There are four types of bituminous fillers, namely, the coal-tar paving pitch filler, the paving pitch mastic filler, the asphaltic paving cement and the asphalt mastic filler. These fillers have gained wide use, due to the adoption of the bituminous filler by the engineers of New York City, where hundreds of openings are made through the granite pavements every week for repair or improvement work on gas, electric and heating lines under the streets. It is almost an impossibility to barrier off an area in New York streets for ten days for the cement grout to set, and if the blocks are shaken by traffic when only a partial set has occurred, the set is destroyed and the joints might just as well be filled with sand.

*Coal-Tar Paving Pitch.*—Coal-tar paving pitch should be a straight-run residue obtained from the distillation of coal tar and shall comply with the following requirements:

1. Melting point shall be not lower than 43 degrees C. (110 degrees F.) nor higher than 52 degrees C. (125 degrees F.)
2. Free carbon shall be not less than 20 per cent or more than 35 per cent.
3. Specific gravity at 25 degrees C. (77 degrees F.) shall be not less than 1.22 nor more than 1.30.
4. Specific gravity of the distillate to 354 degrees C. (670 degrees F.) shall be not less than 1.06 at 60 degrees C. (140 degrees F.) compared with water at the same temperature.

*Asphaltic Cement.*—The asphaltic paving cement should be obtained by the distillation of an asphaltic petroleum at a temperature not exceeding 700 degrees C. (1292 degrees F.) and should comply with the following requirements:

1. It shall be homogeneous.
2. The melting point shall be not less than 54 degrees C. (130 degrees F.) nor more than 63 degrees C. (145 degrees F.)
3. Solubility in carbon tetrachloride shall be not less than 98.5 per cent.
4. Penetration at 25 degrees C. (77 degrees F.) shall be not less than 60 nor more than 100, the penetration test being made



with a No. 2 needle for five seconds, under a load of 100 grams, and the penetration at 38 degrees C. (100 degrees F.) shall not exceed three times its penetration at 25 degrees C. (77 degrees F.), the condition of time and load being as above established. The contractor is notified of the penetration desired on each particular contract and a variation of ten points either way is allowed from this penetration.



Finished Street

5. Ductility at 25 degrees C. (77 degrees F.) shall be not less than 40 centimeters at the penetration called for.

6. It shall not lose more than 3 per cent by volatilization when maintained at a temperature of 163 degrees C. (325 degrees F.) for five hours, nor shall the penetration of the residue after such heating be less than half the original penetration.

The pitch master filler is a mixture of the coal-tar paving cement described and as much hot sand as the pitch will carry and still

flow well into the joints. The sand must be clean and sharp and all of it must pass a ten-mesh sieve. It should be thoroughly mixed with the coal-tar paving cement by stirring. The coal-tar paving cement should be heated to a temperature of not less than 121 degrees C. (250 degrees F.) and not more than 149 degrees C. (300 degrees F.) and should be poured into the joints between these temperatures. The asphaltic paving cement mastic is prepared in the same way by adding sand heated to about 350 de-



Durax Pavement

grees F. to the asphaltic paving cement described. The sand is heated at a central plant, or by using sheet iron curved plates under which a fire is built. The asphaltic cement is heated in kettles and the mastic is made either in a steel wheel-barrow or in a mixer designed for the purpose.

The mastic is dumped on the surface of the street and pushed into the joints with steel hoe-shaped tools. Mixtures of asphalt and tar have also been used with fair success.

*The Joints.*—With the standard blocks which run from 28.5 to 30 blocks to the square yard, about 15 per cent of the surface



yard area will be joint spaces. There are 1296 square inches in a square yard and 15 per cent of this will equal about 195 square inches. For a block averaging 5 inches deep then, we will have to fill  $195 \times 5$ , or 975 cubic inches per square yard. If cement grout is used, about 500 cubic inches of cement are required per square yard, or about one-third of a bag of cement and one-third of a foot of sand per square yard. If the master filler is used, about 585 cubic inches of paving cement and 390 of hot sand would be required, or roughly 2.5 gallons of asphaltic cement and one-fourth of a cubic foot of sand. For the sand cushion 1 inch deep about one-twenty-fifth to one-thirtieth of a yard is required for each square yard, and for a 1 to 3 sand-cement cushion 1 inch deep one-fourth of a bag of cement to the square yard and about one-thirtieth of a cubic yard of sand.

After the asphaltic or tar filler has been used, it is customary to sprinkle the roadway lightly with sand to take up the excess mastic on the tops of the paving stones.

With the four-inch and resurfacing blocks, although the blocks are shallower, there are more joints to the square yard and there is no great difference in the quantity of materials used for filling the joints.

*Durax.*—Durax is the name that has been given to a surface composed of 3-inch or 4-inch cubical pieces of granite. It is laid either in straight courses or in concentric interlocking segments as shown in the picture above. The stone for Durax blocks should be equal in every way to the granite specified for standard blocks and have a French Coefficient of not less than 8. They should be laid with a close joint and about 100 3-inch blocks and about 5 4-inch blocks are laid to the yard. The blocks are laid with close joints and about the same amount of filler is required as for standard blocks. The blocks after laying should be rammed to a firm bed by hand or by a light roller and then the joints filled with a bituminous filler as hereinbefore described. The pavement is noiseless, waterproof, sanitary and durable. It is especially useful for resurfacing worn-out asphalt, wood block, brick or asphalt block streets where the concrete base is still in good condition.

*Granite Curbing.*—In all block types of paving a curbstone is necessary to support both the roadway and the sidewalk and to form a gutter or waterway at the edge of the street. Owing to the widespread distribution of the granite quarries manufacturing curbing, quarries are near each large city and quick service can be given. Granite readily lends itself to any working and can be cut into corners or circles of any desired radius. It can be cut to any width or depth, but in general it splits most readily into shapes where the depth is about three times the width. The curb should be at least five inches wide, as the width gives the

curbing strength to resist shocks and sudden blows. Depth is necessary to prevent the thrust of the sidewalk or earth behind the curb, turning it over towards the street.

The least expensive type of curbing is quarry face or natural-split granite with no hammer dressing. Some city officials prefer dressed curb and all the quarries are prepared to dress the curb on the top, back and face to any specification. The failure of artificial stone curbs has been rather general, but granite curbing, old as the original States themselves, is still in use in many Eastern cities.

The curb is laid either upon a concrete or stone bed and is usually backed up with concrete in the shallow types of curb. The end joints are usually cut on the street by local stonecutters. The most modern equipment for handling curb deliveries is operated by the manufacturers, who deliver the curb to the street by trucks, handle it with portable hoisting equipment and give rapid and complete service to cities and contractors.

*Maintenance.*—There is no maintenance on a granite block street properly constructed with a grout joint. There appears to be a slight maintenance charge for refilling joints in the bituminous filled construction, but this has been so small in the larger cities using this type that granite has been widely adopted as the standard business street. Granite block streets twenty-five years old have cost less than \$10 a mile for the whole twenty-five years or 40 cents a mile a year. Once a street is paved in granite it needs no maintenance and will last forever.

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**PART III**  
**Miscellaneous**

# A SURVEY OF THE FIELD OF HIGHWAY RESEARCH

By W. K. HATT,

Director, Advisory Board on Highway Research, National Research Council.

## Chart of Research.

**F**IRST of all an attempt to plot the field is shown in Figure 1. This chart is useful for the location of a piece of experimental work so that its purpose and surroundings may be determined. The chart has been submitted to a great number of people interested in highway research and highway building, and has so far received so little criticism that it is assumed to be along the right lines.

**THE FIELD OF HIGHWAY RESEARCH**  
IMPORTANT ELEMENTS DEMANDING STUDY ARISING IN THE DIVISIONS OF 1 TO V  
 (STRUCTURED) DIVISIONS (ELEMENTS ARE OFTEN REINTERRELATED)  
 STATIC CHART. COMMITTEES ORGANIZED TO INQUIRY FIELD

I ECONOMICS <small>(GENERAL PRINCIPLES)</small>	II OPERATION	III DESIGN (ROAD)	IV DESIGN (VEHICLE)	V CONSTRUCTION
<b>1. TRAFFIC STUDIES</b> (GENERAL) A. DISTRIBUTION IN REGION B. CHARACTER C. WEIGHT AND DISTRIBUTION D. SPEED E. (TRUCKS) LENGTH F. (TRUCKS) LENGTH G. (TRUCKS) LENGTH H. (TRUCKS) LENGTH I. (TRUCKS) LENGTH J. (TRUCKS) LENGTH K. (TRUCKS) LENGTH L. (TRUCKS) LENGTH M. (TRUCKS) LENGTH N. (TRUCKS) LENGTH O. (TRUCKS) LENGTH P. (TRUCKS) LENGTH Q. (TRUCKS) LENGTH R. (TRUCKS) LENGTH S. (TRUCKS) LENGTH T. (TRUCKS) LENGTH U. (TRUCKS) LENGTH V. (TRUCKS) LENGTH W. (TRUCKS) LENGTH X. (TRUCKS) LENGTH Y. (TRUCKS) LENGTH Z. (TRUCKS) LENGTH <b>2. COMMUNITY NEEDS</b> SYSTEMS OF ROADS IN CLASSES FOR INDUSTRIES, ETC. <b>3. COST OF TRANSPORT</b> CAPITAL COST ROAD VEHICLE FUEL CHARGES OVERHEAD OPERATION MAINTENANCE ROUTINE REPLACEMENT ON ROAD EQUIVALENT UNITS: 2-AUTOS 1-TON TRUCK ETC. <b>4. ECONOMICS OF LOCATION</b> COST OF DISTANCE RISE AND FALL CORNATURE ROLLING GRADE ROLLING CURVE <b>5. FINANCING</b> BONDS TAXES FEE <b>6. HIGHWAY VALUATION</b> INCREMENT OF LAND VALUES	<b>1. CONTROL OF TRAFFIC</b> ROUTING TERMINALS FRANCHISES POLICE REGULATIONS <b>2. ACCIDENT INSURANCE</b> PLANNING SYSTEMS OF TRANSPORT FINANCING ENVIRONMENT RELATION TO OTHER TRANSPORT ORGANIZATION <b>4. FINANCING (SEE II)</b> BONDS, TAXES, FEES <b>5. DISTRIBUTION OF COSTS</b> TRAFFIC PROPERTY POLITICAL UNITS <b>6. MAINTENANCE SYSTEMS</b> <b>7. MAINTENANCE MACHINERY</b> <b>8. MAINTENANCE METHODS</b> ROUTINE REPLACEMENT SNOW REMOVAL, ETC. <b>9. TRAIL MARKING</b> <b>10. COST ACCOUNTING</b> <b>11. SAFETY.</b>	<b>1. SUBSOIL STUDIES</b> PHYSICAL MECHANICAL CHEMICAL DRAINAGE SUPPORTING POWER IMPROVEMENT BY TREATMENT EFFECT OF CLIMATE DISTRIBUTION OF PRESSURE <b>2. BASE COURSE</b> CHARACTER TYPE THICKNESS MATERIALS CRACK SECTION <b>3. SURFACE</b> CHARACTER THICKNESS MATERIALS CRACK SECTION WEAR BY ELEMENTS WEAR BY TRAFFIC TRACTIVE RESISTANCE WEAR OF FUEL WEAR OF VEHICLE INFLUENCE OF LOCALITY <b>4. CROSS SECTION</b> WIDTH CROWN SHOULDER DITCHES <b>5. LOADS</b> STATIC SURFACE INTEGRAL AS EFFECTED BY DESIGN OF VEHICLE <b>6. DESIGN OF INTEGRAL SLAB</b> STRENGTH AND STIFFNESS OF SOIL CELLULAR <b>7. VOLUME CHANGES</b> CRACKS SINKING <b>8. REINFORCING</b> THEORY OF AMOUNT KIND DISTRIBUTION DEFLECTION	<b>1. DESIGN OF VEHICLE</b> POWER GEAR RATIO BRAKING ETC. EFFECT ON LOADS SPRING UNDERPRING DISTRIBUTION ECONOMY OF OPERATION AND MAINTENANCE (SEE AUTOMOTIVE INDUSTRY RESEARCH) <b>3. SURFACE</b> TRACTIVE EFFORT WEAR ON TIRES LOADS MAINTENANCE OF VEHICLE <b>4. ALIGNMENT</b> CURVES (SPEED) GRADES <b>5. CROSS SECTION</b> WIDTH CROWN <b>6. SAFETY</b>	<b>1. MATERIALS</b> BITUMINOUS NON-BITUMINOUS FURNISHMENT MECHANICAL PROPERTIES METHODS OF TEST STANDARD TESTS SPECIFICATION PREPARATION AND TREATMENT (SEE SPECIAL LIST) PROPORTIONING <b>2. MIXING</b> EFFICIENCY OF MIXER CENTRAL MIXING PLANTS <b>3. PLACING</b> <b>4. METHODS OF TESTING ROADS</b> INSTRUMENT CORRES <b>5. DESIGN OF EXPERIMENTAL ROADS</b> <b>6. DRAINAGE</b> PRELIMINARY STRUCTURES <b>7. IMPACT ON BRIDGE</b> STRESSES <b>8. REINFORCING</b> HANDLING AND PLACING <b>9. INSPECTION</b> <b>10. PLANT DESIGN AND CONTROL</b> <b>11. COST ACCOUNTING</b> <b>12. CONSTRUCTION CONTRACTS</b>

Fig. 1

Highway research must be conducted in somewhat of a critical mood. The impression prevails that a large part of our present data is unreliable partly because they have been obtained under conditions which no longer prevail, and partly because the data are misleading without the knowledge of underlying conditions.



Hearsay evidence, rumors and propaganda are not wanting. Unproven statements should be eliminated. Mere argument, unsupported by facts, must be disregarded, and final deductions based upon real and vital data.

*Relation of Highway to Other Transport.*—Freight is finding its way through new channels. Sixty-three per cent of the freight between Bakersfield and Los Angeles, California, is carried over the well known Ridge highway at 16 cents per ton-mile rather than by the Southern Pacific highway at 5 cents a ton-mile.

For the purpose of a view of the entire traffic situation and for a wise State and National policy, traffic studies are of special importance.

It is therefore necessary that the data underlying the economic disposition of traffic among the various agencies of transportation be obtained by trained research workers. Only in this way can we obtain an overhead view of the relation of highway transport to other existing agencies. The wealth of the nation available for transportation is limited and an over-extension of highway transport may starve other agencies, and wipe out existing assets. In this connection it is interesting to notice the preliminary statistics gathered by the Chamber of Commerce of the United States, which estimates that the investment in highway transport, twenty billions, is equal to that in railway transport.

### Economics.

There is an important service to be rendered by the highway engineer in so locating his road that the cost of operation will be reduced, these costs including fixed charges, depreciation, replacement, maintenance of vehicle and road, etc. It is hoped that within the course of a year the cost of operation of vehicles as determined by location and character of highways will be fairly well determined. Professor T. R. Agg, Chairman of Committee No. 1, on Economics of Highway Improvements, has accumulated a large amount of very carefully determined data in connection with the work of the Experiment Station of the Iowa State College, and his committee is concerned with tests of tractive resistance of trucks in New England in which Harvard University, Yale University, Massachusetts Institute of Technology, Bureau of Public Roads, United States Army, Society of Automotive Engineers and the highway commissions of Massachusetts and Connecticut are co-operating, under the direction of Major Mark L. Ireland, Q. M. C.

*Traffic Studies.*—Professor Dougherty of the University of Tennessee has shown the value of a well planned program of regional studies of traffic. Here is an excellent field for local studies by universities.

Present traffic conditions should be studied and those in the near future must be envisaged before an intelligent program can

be framed for the development of any region. In many cases this policy involves the provision of permanent structures, location and grading, to be used without paving until such time as the development of the country and the increased traffic justifies the paving of this roadbed. Instances are not wanting, however, in which the absence of paving under heavy traffic has brought about heavier costs, and a road impossible to maintain satisfactorily. Questions of the length of life of bonds for various types of roads and of the proportion of costs to be provided for by bonds and by current fees, can only be decided upon the basis of physical facts and costs which at present are wanting.

There is a lively interest in the traffic studies which have been planned in a large number of States. The purpose, methods and devices for measuring traffic are yet to be agreed upon. Something more than the count of vehicles is necessary. The proportion of truck traffic and the weight of the vehicles should be known in order that some estimate may be made of the proportion of the maintenance costs chargeable to truck traffic. One of the most complete traffic studies is that now under way in the State of Connecticut in which not only the mechanical features of the traffic but the commodity value, the origin and destination are recorded. A truck loaded with silk products left a mill in Connecticut in the afternoon and was delivered in New York the next morning; the manifest showed the value of this load to be \$100,000. A study of the laws of development of traffic is now about complete under the direction of Dean A. N. Johnson of the University of Maryland. Charts have been drawn showing the development of traffic during four years from one hundred and fifty stations on the highway system of Maryland.

Commissioner Cole of Massachusetts has recently reported a valuable census of the traffic of Massachusetts, which will answer many questions concerning the earning power of the higher type of roads.

Such traffic studies are an important part of the economics of highway transport to which main question others are subsidiary. This cost arises from the road and also from the vehicle.

The chart, Figure 2, is supplied by the Bureau of Public Roads to show the relation between road expenditures and automobile registration. Only during the last year has the rate of increase in total expenditures for the highway exceeded the rate of increase in automobile registration. The increase in percentage of trucks is notable.

*Operation.*—In thickly settled centers the State highway departments take on largely the aspect of traffic departments. The control of traffic, especially with reference to safety, is a paramount issue. In other words, the grave problems which have so long pressed in upon the cities are now appearing on the highways. A



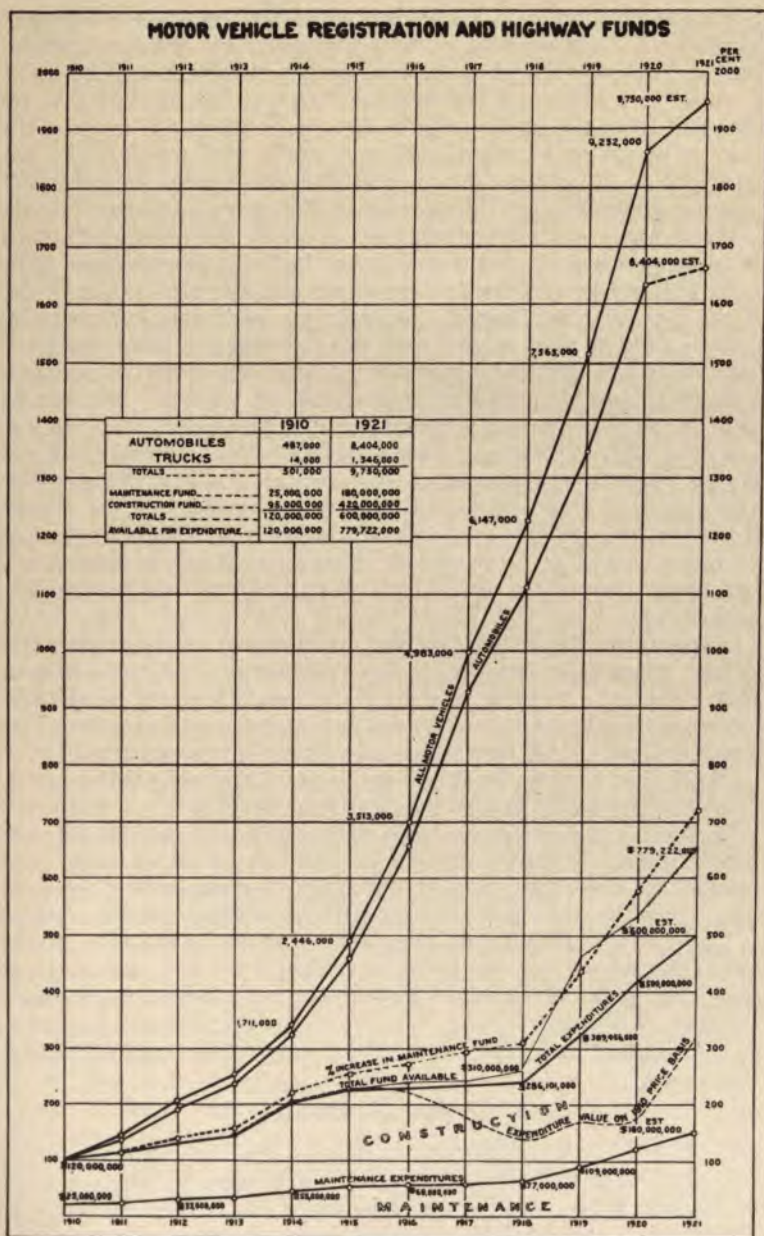


Fig. 2

striking suggestion by J. H. Mullen, chief engineer of the highway department of Minnesota, is that the speed on heavy passenger lines be limited to 40 miles per hour at the maximum and 25 miles per hour as a minimum between the hours of 5 a. m. and 8 p. m. This will force the truck traffic to the use of the roads in the night time. The art of signaling highways needs study, and the recent paper by A. R. Hirst, of the State of Wisconsin, indicates the growing importance of this portion of the operating field.

*Maintenance.*—Maintenance costs, one of the most important elements entering into the economics of highway construction, have in the past not been properly determined and allocated. The choice of the type of road depends greatly upon such data. Something more is needed than a total cost of maintenance from fence-to-fence or from shoulder to shoulder. The traffic, materials, climate, labor costs and all pertinent data should be known. We should know if the cost was a replacement or the result of a misfit of the type to traffic conditions. The Bureau of Public Roads will require a report on maintenance costs on all Federal aid projects according to a standardized system of accounting. In the course of time reliable maintenance data will be secured. In the meantime much can be learned from specific cases particularly in those countries where foresighted individuals have properly analyzed maintenance costs.

It appears to the writer that the maintenance of the roads must assume a larger importance as the construction program becomes more complete. A great deal of experimentation and research is needed to fix upon the correct theory of maintenance of the various classes of roads. An interesting experiment in the maintenance of a gravel road under the direction of A. R. Hirst of Wisconsin shows the possibility of useful research in this line.

*Legislation.*—Restrictive legislation upon the weight of the vehicle should be based upon a careful survey of existing conditions and cannot be decided offhand. A truck should go over State boundaries on main routes without being forced to reduce its load. It is said that only one-half of one per cent of the traffic on our highways is in the form of vehicles over five tons in gross load. The data of research into highway economics are necessary for wise legislation. Roads should be strong enough for economical highway transport. But where and when is a given vehicle economical?

### Design of Road.

In the preceding fields of economics and operation but few references have been made to research activities, although it must be said that there is a live appreciation of the urgent necessity of early studies. In the field of design, however, the engineers are in a more favorable position, because the fundamental mechanical

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principles of the operation of the various types of roads are being defined rapidly. Of course the problem is simple in statement. Given the maximum weight and volume of traffic; to provide a road of sufficient width and strength to carry this traffic over the existing or improved subgrade. The solution must depend upon the characteristics of the region, and will be different in Arizona and Massachusetts. Regional supplies of material and labor and climatic conditions certainly influence the result. The main problem of research lies in the field of the load, the mechanical action of rigid and non-rigid slabs and the properties of the subgrade.

*Subgrade.*—The highway engineer must face all kinds of subsoils, such as the adobe soil of California, which cracks and swells in a remarkable way, sufficiently at times to deform the green concrete of the road slab, and the black soils of Illinois, plastic clays, etc. The design of the road should be related in some manner to the supporting power of the soil. A large volume of research is directed to the study of subsoils and particularly to determine that element of the soil which determines its properties and to the treatment of sub-soils by drainage and the admixture of chemical additions. The most important agencies in this field are the Bureau of Public Roads, the Subsoil Committee under the chairmanship of General E. I. Dupont, organized first as a committee of the now inactive Federal Highway Council, the work by Professor Eno of the Ohio State University, by Clifford Older of the Illinois State Highway Department, and by the University of California.

These researches include the mechanical and ultimate analysis of soils, instruments for determining bearing power and study of water movement and consequent volume changes. Studies are also under way in the Bureau of Public Roads for the protection of the shoulders and other means to preserve the moisture content of the subsoil more uniformly. In California the soil is improved by mixing in coarse aggregate. In some States a layer of tarred paper is placed on the subsoil to prevent the entrance and egress of water which it is thought results in harmful volume changes of the concrete slab. When the studies under way are complete we should have within the year a fairly satisfactory account of the action of subsoils, the means of testing them and the implication which the data carry into the field of design. It is Mr. Older's observation that in the case of the soils of Illinois there is practically no supporting power under expected conditions, and that therefore the concrete slab must be designed as an overhanging cantilever with the load at the corner of the slab. The Bureau of Public Roads has treated some subsoils by the admixture of additional materials such as Portland cement which apparently renders a plastic clay granular in its nature and destroys the plasticity.

*Slab.*—The width of surfacing is closely related to the findings of traffic studies and the habits of drivers. The Committee on Standards of the American Association of State Highway Officials will be the source of authority upon questions of this kind.

As concerns the design of stiff slabs under a specified loading, we have an interesting field of scientific experimentation on a large scale. Some of the experimental roads may be listed as follows:

1. The Bates experimental road two miles long, built by the Illinois highway commission under the direction of Mr. Clifford Older, contains brick surface on concrete slabs of various mixtures and differently reinforced. Complete scientific observations are being made on subgrade conditions and volume changes in slabs with accompanying laboratory tests of the ability of plain concrete to withstand repeated stresses. Loads will be applied in the spring of 1923.

2. Test road 1,320 feet long, oval in shape, built by the Columbia Steel Company at Pittsburgh, California, under the engineering direction of Messrs. Leonard & Aldrich, of San Francisco, and with the cooperation of the Bureau of Public Roads and the California Highway Commission, and by California automobile clubs. The construction includes concrete slabs of various thickness and shape, some with inverted curbs and variously reinforced with steel running from 20 tons to 69 tons per mile. Steel includes structural and high carbon grade, both open hearth. Built in July, 1921, and first loaded November 9, 1921, with 40 trucks, equivalent to the passage of 10,000 trucks per day. Subgrade, adobe soil. Complete measurements of volume changes due to temperature and provision for subsoil moisture. Measurements of other pertinent data. Four tunnels run transversely to the road covered with  $3\frac{1}{2}$  feet of rolled sub-grade. In these tunnels there is an autographic record of the deflections of the slab and the subgrade due to the passage of traffic. The mechanical action of the slabs are determined by various positions of the truck under static and impact conditions.

3. Reinforced concrete precast slab road built in 1920 at Caspar, Wyoming, 2,400 feet long, in desert. Units are 8 feet long, 9 feet wide and 6 inches thick.

4. Experimental concrete highway 2 miles long under construction in Alexandria County, Virginia, under the direction of the U. S. Bureau of Public Roads. Sections of various thicknesses and shapes, with various reinforcement. Preliminary scientific measurements. Normal farm traffic.

5. Experimental road, circular track, concrete base and bituminous top, built by the U. S. Bureau of Public Roads at the Experiment Farm, Virginia. Various combinations of bituminous tops are to be tested under the action of a truck which is guided automatically.



There are several roads built containing variations in aggregate or reinforcing as part of State systems, the data and description of which are not at present available.

We have also the remarkable investigations conducted by the Bureau of Public Roads under A. T. Goldbeck, at the Experimental Farm across the river from Washington. These researches have been reported quite completely in the technical press and need not be described. Mr. Goldbeck has first of all determined the blows arising from the vehicle under service conditions; then he had with a new type of machine dealt blows of various magnitude to slabs of various thickness and designs supported on different classes of sub-grade. When these specimen tests are combined with the service tests the road designer should be in the near future in possession of a body of data comparable to that at the disposal of designers of concrete buildings. It would seem that with the large mass of data that has been gathered together and analyzed, the designer should be able to design a road slab with the certainty that he designs any other structure. What is especially needed now is a body of designers to study these data and project new experimental roads to close up the gaps in this field of research.

*Reinforced Roads.*—The last word has not yet been said on the policy of reinforcing concrete roads. One extreme is a thick, heavy slab, massive enough to withstand such loads as are found in the State of Washington, viz: 20 tons of logs; the other extreme is a thin flexible slab which will deform under a load or under the action of frost and be brought back to its primitive shape by the elasticity of the reinforcing steel. No doubt the adjustment in this respect would be determined by the condition of supply of materials and by a comparison of the maintenance costs of heavy concrete roads and thinner reinforced roads. Those who are designing experimental roads should have this element of research in mind. The amount of reinforcing now generally used is only sufficient to hold together the broken sections of the concrete slab. Research is needed to determine the amount of reinforcing which will be really effective under the various regional conditions of this country.

*Other Types.*—It would seem that in the rapid development of other types of roads the experimental study of brick roads has been somewhat neglected, and we should welcome the efforts of the National Association of Paving Brick Manufacturers to promote research comparable to that now being applied to other types of construction.

*Relation of Vehicle to Road.*—Restrictive legislation on truck loads may result in a redesign of vehicles with new tire equipment or new relations of spring-borne and unsprung weight or multiple axles to carry maximum loads over highways with less destruction

of the road. The recently proposed committee composed of representatives of the Society of Automotive Engineers and the Highway Engineers will consider the mutual relations of the vehicle to the road. The highway engineer also, in conjunction with the automotive engineer, must conduct research into the effect of the various road surfaces upon the operating cost including gasoline consumption and tire wear, and the operating departments must also consider the road surface and alignment in relation to the statistics of accidents. Roads must also be evaluated from the standpoint of tractive effort and safety.

### Construction.

One of the outstanding problems in the construction field in the subdivision of materials, is the cause of surface waving, both in gravel and bituminous roads. Whether these surface waves or corrugations arise from methods of construction or maintenance, or from a lack of homogeneity in the materials, or lack of proper balance of filler and bituminous content, they certainly have come through the action of high speed motor traffic. Whether this traffic operates to produce these waves by reason of spring action or engine impulse or wheel action or otherwise is to be determined. The cost arising from this action is excessive. Research is needed to determine the cause and remedy. H. S. Mattimore of the Pennsylvania State Highway Department and Major F. S. Besson, of the District of Columbia, are active in research upon the cause of waves in asphalt surfaces. The Bureau of Public Roads is making a special study of the corrugations of gravel roads; and is cooperating with the asphalt association in studying the causes of waving of asphalt pavements. A large number of samples have been secured from Washington, Baltimore, New York, Philadelphia, and Detroit.

A research into the efficiency of the operations of concrete mixers is much needed and also a further study of the product of central mixing plants.

The field of research on the fundamental principles of materials and on standardization of tests has been occupied for a great many years. These researches are well fitted to the ordinary university laboratory and are numerous.

A little later the Research Council expects to issue the results of a Census of Research in which the many valuable studies under way in the experiment stations of the various state universities will be listed and described. It is difficult to mention a few of these investigations in a paper of this kind without doing injustice to the large number of devoted research workers.



## LOAD RESTRICTIONS AND HIGHWAY CLASSIFICATION

By HENRY G. SHIRLEY

*Chairman A.A.A. Good Roads Board*

MUCH is being heard these days from our legislative halls about the weight of vehicles and the maximum load they should carry over the road. Nearly every State legislature is considering regulatory laws to govern the weight and operation of commercial motor vehicles. The problem is becoming more and more acute, and some solution must be found that can be uniformly adopted. The writer believes that the fundamental principles underlying this problem are common to every State.

Much stress is being laid on the maximum load, meaning the gross weight of the vehicle and its load, without any other determining factors. The absurdity of measuring the destructive effect to highways in any such terms is shown by the fact that some vehicles have only 50 per cent of their weight and load concentrated on the rear axle, while others have as much as 90 per cent. Is the road designer interested in this maximum load, except as to the carrying capacity of highway bridges? I don't believe that he is.

The factors that must be determined and agreed upon are the axle and wheel loads. When these have been determined, then the need for the gross load limitation will vanish, except for bridges.

The wheel must also have a sufficient width of tread to properly distribute its load over the surface, but with a predetermined axle and wheel load, the road designer can proceed with some degree of certainty, knowing what will be required of the surfacing to safely carry the loads.

The problems of highway design embraces so many factors that it is necessarily very complex. Knowing the maximum axle and wheel loads, the area and character of the bearing surface of the wheel tread, and its impact due to speed, the design for the road surface can be completed.

Another factor which must be considered is seasonal conditions and that brings us to the question of cost—the very crux of the whole matter of design. Must the surface be designed and built to safely carry the maximum axle and wheel load at all seasons of the year, or must there be a seasonal restriction and a classification of the highways?

If the surface is designed to carry the maximum load during that season of the year when the sub-grade is the weakest and its bearing power very low, then much money will be built into the roads that will lie idle and be of no service, except during these few months.

Would it not be much better and more economical to require seasonal restrictions during the danger period by reducing the load to a weight that the surface could safely carry, especially on many of the roads heretofore built that were not destined for such heavy loads? I unhesitatingly say, yes! except on the heavy-duty highways, where the volume of traffic is heavy throughout the entire year.

On the heavy-duty roads the surfacing should be designed to carry the maximum axle and wheel load during all seasons. But on the secondary roads, where the traffic is not so intense, the load should, in my judgment, be made to vary with the critical period and the ability of the surface and sub-grade to safely carry its weight without injury, and so on down to roads of very minor importance. During the late spring, summer and fall months inexpensively surfaced highways will carry the maximum load without injury, but during the late fall and early spring they may be completely destroyed by vehicles carrying such loads.

All roads should, therefore, it seems to me, be classified into three general classes, A, B, and C, as follows:

Class A roads should be the heavy duty highways, carrying a large volume and weight of traffic throughout the year. On Class A roads the maximum axle load should not exceed 18,000 lbs., maximum wheel load not over 9,000 lbs., and bearing load per inch width of tire not over 750 lbs. This should be the maximum load allowed throughout the year.

Class B roads should consist of highways where the greater volume of traffic is of lighter weight units and only a small per centum of heavy units. The maximum axle, wheel and inch per tread loads should be the same as Class A—from the latter part of March or April to the latter part of November or December, varying according to climatic conditions, but from November or December to March or April, the maximum axle load on Class B roads should not exceed 12,000 lbs., wheel load 6,000 lbs. and load per inch of tread 500 lbs.

Class C should compose the unimproved earth roads and the maximum axle load from March or April until November or December, 12,000 lbs., wheel load 6,000 and load per inch of tread 500 lbs., from December to April axle load 6,000 lbs., wheel load 3,000 lbs. and load per inch of tread 300 lbs.

Each class of road should be marked at stated intervals and at all intersecting roads by a sign giving the load and the seasonal



restrictions. A severe penalty should be imposed for the violation of any of these restrictions for over-loading. With such plan put into effect, the laying out and designing of the highways of the country could proceed with some degree of certainty, knowing that the money invested would be properly conserved and the roads protected, as well as safeguarding the usefulness of the improved roads heretofore constructed for many years to come.

## TRACTIVE RESISTANCE OF ROADS

### What Reducing This Resistance Means to Owner and Driver

By MAJOR M. L. IRELAND AND 1ST LT. H. C. MITCHELL, Q. M. C.

**E**VERY driver of a motor car knows that on certain roads his car "pulls" better and can make more speed than on certain other roads. He knows that there has been no change in the motor but that there is a difference in the resistance of the different roads. He knows that more and more power is required for each increase of a mile per hour in the speed. He knows that some of this is due to increased air resistance at higher speeds. He also knows that there is a speed (not the highest, but usually around 15 to 20 miles per hour) at which his car is the most efficient.

Many drivers do not know that they greatly increase the resistance and cost of operation of their car by:

- (a) Driving at uneconomical speeds;
- (b) Failing to reduce speed proportionate to loads and roughness of roads;
- (c) Driving grades with the wrong gear;
- (d) Driving with under-inflated tires or with anti-skid chains when the latter are not needed;
- (e) Filling crank cases, transmissions, and differentials too full of oil;
- (f) Using the wrong lubricant or not changing it frequently enough;
- (g) Driving when wheels, shafting and other parts are out of line.

Drivers sometimes learn by experience that in cold weather stiff grease in transmission and differential slows everything down. But how many persons know anything about how much each of these things affect their car and its cost?

Few know how to find their vehicle cost per mile. Almost no one knows that his vehicle mile cost is frequently more seriously affected by the character and quality of the road used than by many of the factors mentioned above. Tires are sold on their anti-skid and pulling qualities but have you ever seen any real figures for either quality? Dependable information on which to select the right vehicle and tire to fit his normal load, road, and speed requirements, would be a gold-mine for the highway transportation



man. Knowledge as to which type of vehicle and tire is the most destructive to a given road, the conditions under which it occurs, and why it occurs, would pay by saving a large part of the taxes and the public debt. Legislation would be founded upon road facts rather than upon imagination.

This shows, almost in a paragraph, many of the most important factors in the problems of highway transportation, construction, maintenance, and legislation. There is much talk and little evidence. The basic information on what happens, what forces must be overcome, and how to do it with the least gasoline, and the least wear and tear on vehicle, tire, and highway, is lacking. We now burn too much gasoline in order to pound vehicle, tire, and road to pieces. Not all, but much of these fundamental data leading to the above information are comprised within traction resistance (the resistance to being drawn) and the shocks and vibrations absorbed by the vehicle and the highway. It is these fundamental things which are to be weighed and measured.

The following explanation of what traction resistance is and why it is important to him is intended especially for the thinking man on the driver's seat:

The traction resistance is an extremely variable quantity. No two types of vehicles on the same road will have the same traction resistance. No two highways will offer exactly the same resistance to any one vehicle. No one can give the traction resistance of a given highway. He must name the highway and the vehicle and then the amount of load carried and the speed before he can give a traction resistance value. It is very difficult to measure traction resistance values more closely than within plus or minus 5 per cent of the truth. Different vehicles, or the same vehicle, loaded and unloaded, will show a variation of as much as 25 per cent either side of a mean value given for a road without mention of these other factors. A speed of 32 miles per hour shows with a heavy truck six times the resistance at four miles per hour.

Most of the available data from the many experimenters of the past lose much of their value because the facts just cited have been ignored. Much really good data are apparently conflicting simply for lack of care in recording the different conditions under which the tests were made. Then again much confusion is caused by differences of opinion as to what factors should and should not be included in traction resistance.

The traction resistance or "gross resistance to being drawn" includes wind and air resistance, vehicle coasting resistance, including tire resistance, road surface friction, and impact resistance. This statement, for simplicity's sake, neglects the frictions in the

motor and the resistance which every one has experienced when he tries to gain speed and the "carry" with which a vehicle at high speed resists breaking before it stops, also a few minor resistances too small for discussion.

The wind resistance refers to the effect of air moving over the ground and will hinder or assist the vehicle according as the wind blows in the opposite or same direction in which the vehicle moves. The air resistance refers to the effect produced by driving a vehicle through still air. For speeds up to about fifteen miles per hour, the air resistance is small and can usually be neglected. At higher speeds, it increases rapidly, and at speeds of about twenty-five miles per hour, it becomes the dominant force in the total resistance.

The vehicle coasting resistance, exclusive of tire resistance, is due to the mechanical friction of the vehicle parts from the neutral position of the gear shift through the fellow of the drive wheels, and depends chiefly on the vehicle design and construction.

The tire resistance is due to the compressing and reforming of the tire and depends chiefly upon the tire construction and material.

The road surface friction is due to lack of an ability to return all of the energy put into the road surface material, and is apparently constant for a smooth level road of the particular type considered. For the road material this is a counterpart to the resistance of the tire material. For soft roads the resistance split off from this resistance to account for displacing road material is usually called displacement resistance.

The impact resistance is due to the lack of smoothness of the road surface, and will increase rapidly with the speed and to a less extent with the load.

It will be evident, that of these five principal resistances, the road surface friction and impact resistance alone are influenced by the particular type of road considered. Impact resistance is also influenced by the type, dimensions, and quality of the springs, and by the speed of the vehicle.

Valuable experiments by the United States Bureau of Public Roads, various State highway commissions, Iowa State College, the University of Michigan, Massachusetts Institute of Technology, and other similar institutions, have recently been made, which furnish considerable data for certain special cases.

The following table showing the economy of improved road surface was given out by Edward N. Hines, chairman of the Board of County Road Commission of Wayne County, Michigan, and is reproduced from the Service Bulletin, Iowa State Highway Commission:



<i>Type of Road</i>	<i>Pounds pull per ton</i>	<i>Miles per hour</i>	<i>Miles per gallon</i>
Dirt road.....	92 to 218	4.6	5.78
Gravel.....	78.2 to 81.3	9.5	7.19
Macadam.....	64.3	....	9.48
Paved road....	27.6	16.4	11.44 to 11.78

Data by the good road section of Iowa State College showed that while it takes 218 pounds pull to move a ton on an earth road, the same load can be moved on a hard paved surface with a 27.6-pound pull. Information is not available as to the type of vehicle in this case or condition of loading.

Tests of a two-ton truck on the road from Detroit to Jackson and Ann Arbor showed that, while it was only possible to obtain a speed of 4.6 miles per hour on a dirt road, the speed rose to 16.4 miles per hour on a paved road.

A test of a two-ton truck made in the vicinity of Cleveland, Ohio, showed a mileage per gallon of gasoline of 5.78 on dirt roads and 11.78 on paved roads.

The values given in the table by Mr. Hines, indicate the great decrease in tractive resistance (pounds pull per ton) and increase in speed and mileage that can be expected when road surfaces are improved.

The following figures give a graphical illustration of the importance to the vehicle owner and the man in the driver's seat of decreasing tractive resistance by means of improved road surfaces.

Fig. 1 illustrates the relative amount of time spent by a driver on various kinds of work incident to making deliveries over different kinds of roads. The values for paved roads are average times taken from the results of an investigation, covering several months, of the delivery system of the R. H. Macy department store of New York City.

The time required by the driver for the work incident to this same delivery system if the roads were gravel, or sand, instead of being paved, has been computed using Mr. Hines' data.

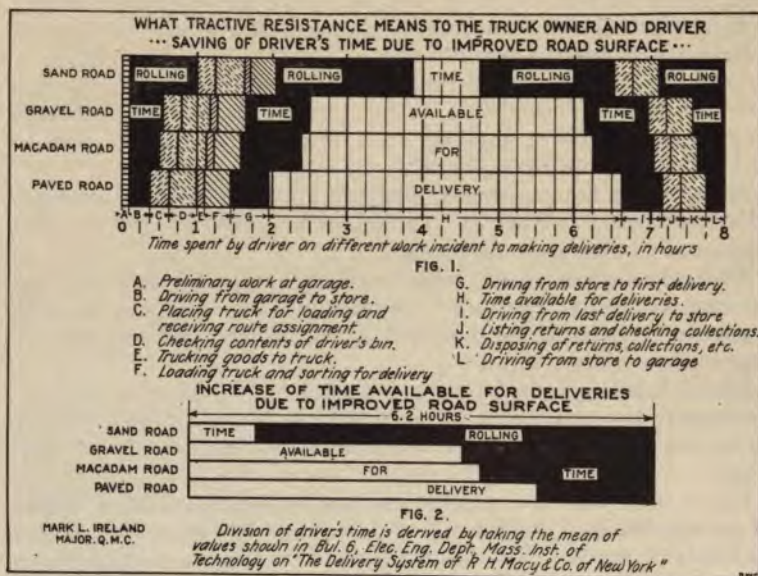
Representing a kind of highway by a belt in this manner shows but one value, that of a practically new road. Of course, the tractive resistance varies with the state of maintenance, and other conditions.

The cross-hatched areas "A," "C," "D," "E," "F," "J," and "K" represent non-rolling time spent in routine work chiefly in connection with administration, and are therefore the same for each kind of road.

The areas in black "B," "G," "I," and "L," represent rolling time spent in travelling over the typical distance necessary to reach the point of delivery. These times were devoted to transporta-

tion as distinguished from time for making deliveries. The distance travelled is the same in every case. The difference in time is due entirely to the difference in road surface, and the resulting slower speed.

The remaining area "H" represents the remaining time in an 8-hour day which may be considered as time actually available for deliveries. Of course there are fractional rolling times in the delivery period proper which would make the difference in ac-



complishment on different roads even greater than is shown.

Fig. 2 pictures clearly the approximate time away from the store and garage. The whole transportation problem is now simply a matter of how best to divide this time between rolling time ("B," "G," "I," and "L" in Fig 1) and delivery time ("H" in Fig. 1). The reason for existence of the delivery system is to distribute the packages in time "H." Time spent unnecessarily in any other way is defeating this purpose. It is impossible to move the delivery district closer in terms of distance to the business center. In fact, the delivery distance tends to slowly move farther away. The only way of overcoming this difficulty is to move the delivery district closer when measured in time.

The truck owner, or man on the driver's seat, should note how much this reduction of time between points is reduced by the great reduction of the black areas and increase of the white ones, as the road is improved. For example, the figure indicates that with



a paved road, five times as many deliveries can be made in the delivery district in each day, as would be possible if the road were of sand. This is entirely due to the decrease of traction resistance.

This means that one truck over a paved road can do approximately the work of five over a sand road. On the poorer road the load would have to be reduced to avoid damage to loose packages, and because it would be folly to carry more than there was time to deliver. More expensive wrapping and crating is required. The cost of transportation, in all of its steps from producer of raw materials through manufacture, wholesale and retail, to consumer, is now found to be a large part of the explanation of the high cost of living. Cutting transportation costs in this very marked degree means lower prices and slightly higher taxes. Every man is a consumer. Shall we stick to the same road, or insist on the good road, lower prices, knowing that taxes will be slightly higher?

The importance of the subject of traction resistance, and the lack of knowledge of the effect of speed, load and differences in design of vehicles, tires, etc., upon traction resistance, has given rise to many experiments as previously stated. The work is slow, painstaking, and expensive, for it must have the accuracy of good city surveying, but with the difference that the observers and their instruments must be bumping and bounding over the road at variable speeds, while the engineer and his instruments may remain quiet during the time the work is being done. These facts have discouraged and baffled many until it has become necessary to undertake the work in a very earnest and thorough manner.

The advisory board on highway research, National Research Council, of which Dr. W. K. Hatt is director is encouraging and coordinating all the highway research for this and other purposes. It has organized committees to cover the various fields. Under the direction of the Committee on Economic Theory of Highway Improvement, of which Professor T. R. Agg, Iowa State College, is chairman, there is being conducted coordinated traction resistance investigations in Iowa, Michigan, Kansas, New England, and elsewhere. The Iowa work has been aimed at development of methods and instruments and data upon conditions under which economy demands that grades should be reduced. This latter phase has been taken up in considerable detail by Professor W. E. Lay of the University of Michigan, working with the Michigan Highway Commission.

In October, 1921, Dr. Hatt organized a subcommittee (of the above committee) to deal with the traction resistance of roads, the object of which was to foster the Quartermaster Traction Resistance of Roads Research, then in progress in the Electrical Engineering Department, Massachusetts Institute of Technology, and to encourage other researches upon the same subject elsewhere.

In August, 1921, the coöperation of Yale University was invited and the invitation was accepted. Yale's part covers laboratory analysis of internal losses of the vehicle and tire resistance.

The purposes of this research are:

- (a) To determine the best types of instruments for the work and why;
- (b) To determine the most suitable technique for this class of research;
- (c) To produce the desired physical data for tractive resistance of the vehicle named below, tires, loads, and speed on concrete surfaces, plus that minimum amount of data concerning other surfaces which will afford some basis of comparison;
- (d) To determine sliding friction upon the different road surfaces tested;
- (e) To make such auxiliary measurements for investigations as might be necessary to interpret more definitely the results of the major investigation.

Experiments will cover a considerable number of vehicles with different types and sizes of tires, under various conditions of speed and loads, and on several types of road surfaces. A brief summary of the equipment available and the program for the tests follows:

*Vehicles on hand.*—4 types as follows: Quartermaster Std. B truck equipped with solid tires, pneumatic tires and steel tires. Cushion tires will probably be added. This is the "backbone" vehicle of the test. Other vehicles are Mack 7.5 ton truck, 3-ton Detroit trailer, and White 1.5-ton chassis with staff car body.

*Vehicles available on call.*—2 types as follows: White 1.5-ton chassis with truck body and with pneumatic and solid tire equipment. G. M. C. 1-ton chassis with cargo or ambulance body.

*Total vehicle types on hand and available:* 6.

<i>Tire types on hand</i>	<i>Size</i>	<i>Types tread</i>	<i>of Mfg.</i>	<i>Make</i>
Pneumatic.....	3	2	2	2
Solid—New.....	8	6	..	6
Worn out....	3	1	..	1
Totals.....	14	9	2	9
<i>Tire types to be added</i>				
Steel.....	2*	1		
Cushion Rubber....	2*	1		
Totals.....	14	2		

\* Sizes already in use.



*Speeds.*—Range from 5 to 25 miles per hour normally, but at times the grades selected for coasting tests with the accelerometer range as high as 40 miles per hour.

*Loads.*—Range from empty vehicles to 20 per cent of capacity.

*Types of road tested.*—Cover concrete with broomed and with belted surface, penetration bituminous macadam, old oil treated macadam, oiled gravel, brick and earth. The work, in order to limit the time required to produce usable results from the research, and because of the apparent greater general public interest in concrete at the present time, will be thorough on concrete first. Thorough test of other types must be either postponed until later or undertaken elsewhere.

This subcommittee consists of representatives of the following interests:

- Harvard University—Prof. Comfort A. Adams, chairman.
- Committee on Economic Theory of Highway Improvement—Prof. T. R. Agg.
- U. S. Army and War Department, Major Mark L. Ireland.
- U. S. Bureau of Public Roads, Division of Investigation and Tests—Mr. A. T. Goldbeck.
- Massachusetts Department of Public Works—Commissioner John N. Cole.
- Connecticut Highway Commission—Commissioner Chas. J. Bennett.
- Massachusetts Institute of Technology—Prof. D. C. Jackson.
- Yale University—Prof. E. H. Lockwood.
- Society of Automotive Engineers—Dr. H. S. Dickinson.

The results from these several investigations will appear in the technical press from time to time as the work progresses.

## THE ECONOMIC EFFECTS OF THE PASSENGER MOTOR CAR

By ROY D. CHAPIN,

*Vice-President of the National Automobile Chamber of Commerce.*

EVERY forward step in the improvement of the world's transportation facilities with one single exception has tended toward the concentration of traffic in the large masses and toward the concentration of social life into large and highly centralized communities.

The exception is the modern passenger motor car which for the first time provides the masses with individual mechanical transportation.

The measure of its influence is, therefore, to be found not only in its immediate effects upon the economic life of the country but also in the broad influence which it seems destined to have upon our social fabric.

Ten years ago the total motor vehicle registration in the United States was 501,000 cars of which 14,000 were trucks. The motor vehicle estimates for 1921 show that 9,960,000 passenger motor vehicles are traversing our highways today. The total investment based on an estimate average of \$75 per car reaches the staggering total of \$7,460,000,000.

Estimates prepared by the Bureau of Public Roads show that the total number of passengers carried one mile by automobiles in 1921 was 70,820,000,000. This is upon the average of  $2\frac{1}{2}$  passengers per automobile and an annual average per automobile of 3,500 miles.

In an annual census taken by the United States Bureau of Public Roads in California during 1920, the average number of passengers per automobile was found to be 2.2. In the Connecticut census of 1921, the average was 3.25. These counts taken in conjunction with the records of counts taken by several State highway departments indicate the estimate of  $2\frac{1}{2}$  passenger car automobiles to be conservative.

From the citation of these figures alone, it is thus evidenced that within the span of ten years we have seen a tremendous evolution in our transportation problems and one that must carry with it, because of the mere size of the problems so afforded, far reaching ramifications.

In the days preceding the advent of the passenger car, life in this country was fairly definitely restricted to the average daily



traveling capacity of the horse from and to the railroad or the trading center. True, numerous exceptions can be made to this general statement, as in the case of the grower of live stock who was accustomed to drive his product to the railroad on the hoof. But despite cases of this character the economic zones of production were fairly well defined by the horse plus the railroad and it was not until the motor vehicle found its way on the highways that we first obtained a glimpse of a new movement in community life.



*Photo by J. K. Hillers*

Of all the passenger cars about 90 per cent are used generally  
for business

Today the cruising radius of the individual is practically unlimited. Stepping into his passenger car he can make a round trip of a few hundred miles without difficulty in a day or, if he desires, can make numerous shorter trips. Thus one of the first changes which has been wrought by the passenger car is the bringing into life of a new understanding of our mutual problems through a new understanding of our fellow human beings as well as a broadened life for the individual. As we see new things and new people, the natural desire for equality inherent in each of us causes us to try out the new methods which we see others using, and the result is a natural stimulus in our productive effort which is far beyond the range of any mathematician to calculate.

The truth of these statements is emphatically demonstrated by answers to thousands of questionnaires directed to passenger car users of the United States by the National Automobile Chamber of Commerce.

The replies received indicate that of all the passenger cars about 90 per cent are used generally for business, while of the few owners whose chief purpose in the purchase of a machine is recreation, half use their cars instead of the trolley cars, while 50 per cent of the remainder state that the passenger car has solved their housing problem by permitting them to take homes farther away from the business district. A typical example of recreational use is that of a farmer 14 miles from town whose family can now enjoy community and social life.

Of the actual mileage of cars on which figures were obtained about 60 per cent was for strictly business purposes not including use of cars in place of trolley or railroads or for shopping. The average increase in business productivity due to motor cars was 56.7 per cent. Translated into working capacity this means that the 9,960,000 cars in daily use in America add every day the equivalent of over 4,500,000 workers to the nations productive forces. This is equal to nearly a fifth of all the wage earners in America.

Nor is it only in the increased agency of the individual that the motor vehicle has stimulated productive life in America. As the passenger car comes into more general use, as city after city, State after State, show a uniform increase in the number of passenger cars upon their highways, new markets have been added to the industries of the world. The thousands and thousands of men engaged in the production of the motor vehicle, from those who mine the ores, cut the lumber and manufacture the fabrics which go into its composition down to the men who actually assemble the cars and then distribute them, all receive their employment through the motor vehicle, and as their ranks are increased the buying power of the nation grows to an enormous extent, thus opening new and profitable markets for the produce of the farmer, the loom and the mine.

These, however, are statements portraying the influence of the motor vehicle upon our mass production and our larger economic problems.

It is in the examination of the uses to which the individual puts his passenger car that we find the most striking examples of what the passenger car is doing to stimulate life in America.

It has already been pointed out that the cruising radius has been immeasurably broadened by the introduction of the vehicle. This means that the factory laborer in Detroit can today live several miles away from the place where he works, can have the comforts of a home at a lower cost than he could formerly and



can even, if he desire, have a plot of ground on which to grow his own vegetables. The business man today is pushing farther and farther away from the center of the city, and as the congestion is relieved in our larger communities, we may expect to see the slums giving away, thus making for higher standard in our future generations.

There is another consideration not generally appreciated yet but which may have a very marked influence in the future. This is found in the fact that as the farmer purchases his car, he tends to turn to markets farther away from his present selling points unless he happens to be most advantageously located. In some cases we find him living in a small community and, as the farmer does in France, taking his laborers out with him in the morning to the farm and returning in the evening. In the first case, we find the complexion of the small town changing—in some cases losing ground, in other cases shifting its facilities to care for the city dweller who is now able to visit it where formerly he stayed within the confines of the city.

Both of these are large movements which will proceed slowly and it is too early yet to see what the final effect will be. We already have a glimpse, however, of a somewhat similar situation in the influence of the motor bus on education, where we have seen the smaller and less efficient unit give way to the modern community school house. Students are brought in from miles around the country way by the motor vehicle at a lower net cost to the district unit. The same statement is true of church life.

Another and notable influence exerted by the passenger car has been the release of the farmers family from the chains which formerly held them to the farm. The farm wife of today goes to the rural community at will. She does her shopping and goes to a movie, attends a community gathering at which better practices in cooking and farm management are taught. Her children have the same opportunities with better schools made possible through improved transportation. All of this speaks for a higher standard of living, keener enjoyment and sooner or later will have its effect upon the trend of our civilization.

Perhaps one of the effects of the motor vehicle has been in the higher health standards which it has made possible. More than 100,000 passenger cars are used daily by physicians whose actual physical spheres of labor are thus immeasurably increased. Far more important, already thousands of lives have been saved through the ability of the practitioner to eliminate time and to arrive at the place of casualty or sickness.

Particularly is this true in the case of the rural dweller whose isolation in the past due to the lack of adequate transportation facilities and poor roads has caused many a case of suffering and mortality on the farm where quick relief would have saved both.

The mere use of the machine has caused millions of people to spend more time outdoors than heretofore and in this ounce of prevention the lives of hundreds of thousands have been prolonged.

It is significant to notice in this connection that the recreation afforded by the passenger car is recreation for the family rather than for the individual alone.



The new and the old way of going to town

Thousands of salesmen now use passenger cars. The territory handled by each has been greatly increased and in like measure the cost of distribution has been cut down, while those living in more remote places have an opportunity to see broader lines of goods which the larger house has to offer.

The business man has found the car an indispensable factor in the elimination of lost time. Every large business house today has its motor passenger car as has the national government and its subdivisions. In our ambulances, our fire prevention apparatus, our telephone system and in fact in every field of commercial, governmental, scientific and social endeavor, the passenger car has come to occupy a definite place in the scheme of things.



## THE UNDERLYING ECONOMIC TREND IN TRANSPORTATION

By WINDSOR T. WHITE

*Chairman, National Motor Truck Committee, National Automobile  
Chamber of Commerce*

VARIOUS methods of transportation have been employed from time to time in the handling of less-than-carload shipments. In the last few years embargoes incident to the World War, increased cost of shipments by rail, and delays have resulted in switching many manufacturers to the motor truck. In fact, twelve hundred million tons of freight, or nearly half the 2,504,000,000 tons carried by the railroads, is the average tonnage that now annually passes over the highways in trucks in the 1,000,000 trucks now in use.

In the majority of instances you will find on examination that motor trucks are handling less-than-carload shipments within a radius of 50 miles of terminal points on a door-to-door basis. It is only in scattering cases involving special merchandise that trucks will be found beyond this radius. There are over 600 organized motor express lines in the principal terminal centers doing business on this basis today, in addition to the vast tonnage that is shipped in trucks owned and operated by shippers themselves. Certainly, a situation of this character, involving as it does an invasion of the railroad field, could not have sprung to full strength and maturity without the operation of the laws of economics.

Edward Hungerford, an authority on rail freight transportation, emphatically asserts that "old-time railroads for years past have said that a freight car did not begin to make money until it had hauled its goods at least 40 miles. Today the modern generation of operators will come nearer to putting this figure at 80 miles. Up to a distance somewhere between these figures—and undoubtedly far nearer 80 than 40—the vast terminal charges of the American railroad nullify the profit of the haul itself. This is a principle of rail transportation so well understood by all competent authorities today as to be open to no dispute whatever."

With this evidence at hand it can be clearly seen that the short-haul traffic of the railroads has not been and is not today profitable. The railroad executives themselves do not gainsay this premise, but openly acknowledge it. Only the other day Gerrit Fort, vice-president of the Boston and Maine Railroad, in commenting on the place and importance of the truck as viewed by the railroads,

declared that "the truck had come to stay. It represented an economic change in transportation conditions which was little short of revolutionary."

Many shippers have already discovered this new transportation pulsation in the shipment of less-than-carload lots. Upon investigation they have found that it is cheaper to ship such goods by motor transport. It is certain that were motor transportation employed in handling this class of goods, the shipping cost would be lower and the transaction a door-to-door over-night delivery; whereas, the rail line might require two or three days to accomplish the same service. It should be borne in mind that in shipping



As much package freight in all four classes is shipped now by trucks between New York and Philadelphia as by the Pennsylvania Railroad

i.e. short distances, four to five handlings, cartage at both ends, and, in many cases, packing and boxing, are eliminated. These are items well worth considerable thought, for they must be included in the rail freight rate. Do you realize that as much package freight in all four classes is shipped now by trucks between New York and Philadelphia as by the Pennsylvania Railroad?

A short time ago a prominent traffic director pointed out that if shippers would make an analysis of charges that cover their shipments they would be in an excellent position to ascertain the amount it costs to make less-than-carload shipments. If shippers would compare these costs against the same shipments moving by motor truck he believed that shippers would be in a position to eliminate a number of the cost items by reason of the fact that it is not necessary to go to the same expense for packing or boxing freight shipments when moving by motor truck, inasmuch as there is usually no transfer in transit.

If you have been to Cincinnati recently you probably have become acquainted with the large role that motor trucks are playing in the exchange of freight between the eight railroads that enter



Cincinnati. This allocation of transfer freight to the trucks has meant the release for the main-line movement of these railroads, which is their most permanent and profitable sphere of operation, 66,862 cars; the elimination of 300,000 switching cuts; the advancement of the freight movement 52 hours, and a saving of 30 per cent in labor through the elimination of the rehandling of tonnage.

By the very nature of things the motor truck has become an ally rather than a competitor of the railroads. "The motor vehicle and the aeroplane are more likely to develop new transportation fields



Secretary Hoover's Department of Commerce recently declared that "the motor truck has given every town an extended radius of food supplies by some 50 miles and thereby protects such vital matters as milk and perishables against the first shock"

of their own, rather than extensively to invade those of the railroads. The telephone did not wipe out the telegraph; typewriters have not eliminated the use of pens and pencils. To the extent to which motor vehicles are likely to take over the short-haul freight traffic the railroads will probably be immediately benefited financially, because short-haul business is becoming increasingly unremunerative on account of the high proportion of terminal costs which it must sustain." These prophetic words of Elisha Lee, vice-president of the Pennsylvania System, crystallize in many respects the conservative trend of future thought.

In city deliveries proper there has also come about a corresponding saving by the extensive use of trucks. Only last fall a prominent business house in New York City, with large haulage de-

mands, made a survey of its transportation routes. Out of this study it developed that the cost per mile to operate a 2-horse team carrying one ton was 48 cents. On the other hand, the cost for operating a truck of the same capacity was only 20 cents, a clear saving of 28 cents. As the horse outfit covered 400 miles during the month under observation, there would have been a saving of \$112 on this one team alone during that month through the use of a truck.



In the opinion of prominent lumbermen all mules and oxen now in use in southern lumbering will be replaced by tractors and trucks in the next three years

In the opinion of E. E. La Schum, general superintendent of motor vehicle equipment of the American Railway Express, "the maximum daily horse mileages in heavy and medium heavy haulage are 20 and 24 miles respectively. The average is not much more than half this, 12 and 14 miles. A motor truck can cover from 30 to 100 miles a day readily, although it is seldom as low as 30 and not often above 60; the average is below 40. The greater mileage of the motor truck may be used to give better and more frequent service within the area formerly served by horses. Or, it may be used partly to extend the area and partly to improve the frequency of delivery. Being mechanical, motor-truck delivery is precise and accurate. It is not affected by weather or road conditions, as compared with horse service, which is seriously



interfered with and sometimes stopped by the snow and ice of winter and the excessive heat of midsummer."

It was not surprising, therefore, to find a short time ago that the citizens of Milwaukee were having their milk delivered to them at a saving of two cents a quart because the milk companies had motorized their delivery services. The companies had discovered that their trucks travelled ten miles to every two for the horse-drawn wagons; consequently, it cost only nine cents to deliver a



In the opinion of Gerrit Fort, Vice-President of the Boston and Maine Railroad "the truck has come to stay. It represents an economic change in transportation conditions which is little short of revolutionary"

can of milk which formerly cost twenty-seven cents by horse-drawn wagons.

The imminency of the realignment of transportation in favor of trucks is further shown by the fact that there are approximately 10,614 fewer horses and 1,784 fewer stables in New York City today than in 1919. Other localities beside New York report similar reductions in the horse population. Registered stallions in Wisconsin decreased from 2,437 in 1918 to 1,688 in 1920, or nearly a third. Ohio used a hundred thousand fewer horses in 1919 than she did in 1917.

In the realm of agriculture, trucks are playing equally as important a role. According to the United States Bureau of Crop Estimates, 134,400,000 tons of farm products are carried over the highways to the railways annually, in addition to huge amounts of farm tonnage which goes in trucks direct between farm and market. Secretary Hoover's Department of Commerce recognized this economic trend by recently declaring that "the motor truck has given every town an extended radius of food supplies by some 50 miles and thereby protects such vital matters as milk and perishables against the first shock."

Agricultural sections, as a general thing, are remotely situated and usually a distance of from one to fifty miles from transportation facilities. Under such conditions the farmer should be provided with swift transportation, such as trucks, for moving crops and produce to market.

"It is the motorized delivery alone that has encouraged the farmer and produce raiser to greater efforts, inasmuch as it permits them to operate at more distant points from the city where land values are within their means. Today it is possible for farmers equipped with motor trucks to deliver fresh vegetables to the market daily from points at least eighty miles distant. The market hours for securing premium prices in certain kinds of produce and farm products demand a flexibility in service which cannot be supplied by the railroad." This was the comment made by Ralph H. Mattheissen, special assistant to Postmaster General Hays, in discussing recently the vital relationship of motor trucks to agriculture.

Our cotton, corn and wheat can now be marketed at less expense, for the Bureau of Crop Estimates of the United States Department of Agriculture has discovered after an exhaustive series of experiments with horse-drawn and motor-driven vehicles that the motor vehicle travels 25 per cent longer distance, makes 183 per cent more round trips, carries 83 per cent more cotton, 48 per cent more corn, and 50 per cent more wheat. This work can be done at 37, 45 and 50 per cent of the ton-mile cost of wagon-hauled cotton, corn and wheat, respectively.

On one day last summer 1,000 head of sheep were delivered in trucks to the Kansas City stockyards before 10 a. m. The total number received totaled 9,000 head. About 500 cattle and swine were also delivered on the same day. Stockmen claim that trucks have a decided advantage in that they lessen the time the stock is in transit; in case of swine in hot weather, losses are minimized by reason of better ventilation and less irritation. Formerly, the stockman used to drive his stock to market, with the result that overheating caused shrinkage and a drop in the market price.



According to Government figures, our farmers lose annually \$300,000,000 on account of the extent of bad roads between farms and markets. In the opinion of J. Ogden Armour, the Chicago meat packer, this is far too great waste and "we should contemplate this figure in connection with the high cost of living. There is no more serious problem before us today than the matter of reducing the cost of getting the products off the farm to the table of the consumer. One step, at least, in the solution, is plain—better roads."

No field of motor transportation perhaps presents such great transportation problems as are to be found in the production of petroleum. In the rainy season the soil in most of the oil fields becomes exceedingly soft. For the entire distance between Lusk and Lance Creek oil fields there are practically no level stretches. Approximately 75 per cent of the hauling in the Texas and Oklahoma oil fields is therefore carried on today by specially designed truck and trailer combinations.

There is every reason to believe also that in the transportation of coal and other mine products from the mouth of mines there will be from now on a marked tendency to utilize power trucks. Just how extensive this movement will be may perhaps be judged from the fact that the products of approximately 3,200 mines are being carried by either motor truck or wagons at present.

Just a short time ago the opinion was ventured by several prominent lumbermen that within the next three years all mules and oxen now in use in Southern lumbering will be replaced by tractors and trucks. Various methods of transportation have been employed from time to time in the handling of our forest products; but in the last few years lumbermen in general have displayed a keenness for inquiry and observation that has resulted in the development and use of many new devices, especially trucks, intended to save both time and money for lumber producers.

Truly, as President Harding pointed out in his first message to Congress, "the highways are not only feeders to the railroads and afford relief from their local burdens; they are actually lines of motor traffic in interstate commerce. They are the smaller arteries of the larger portion of our commerce, and the motor car has become an indispensable instrument in our political, social and industrial life."

## THE VALUE OF THE MOTOR BUS

By A. J. BROSSÉAU,

*Member, Highways Committee, National Automobile  
Chamber of Commerce*

GOOD roads have always been considered the keynote of all highway transportation, but their real value was not fully appreciated until the public began to realize how inadequately it was being served by the regular transportation agencies, namely, the railroads and the electric trolleys, and how essential



"De luxe" motor busses are now operating between various cities in California and other States. This bus has established a record of 20,000 miles in 61 days between Los Angeles and Redlands, California

it was to obtain relief by means of motor vehicles operating on highways.

The motor truck for the transportation of freight and the motor bus to carry passengers are the logical development of our recent good roads program. The motor truck showed its value even



when the roads were poor and will still further prove its utility as the roads are improved. The motor bus is a more recent arrival and has not yet reached the development of the motor truck in this country, for several reasons.

Abroad the use of the motor omnibus for the transportation of passengers started almost immediately upon the practical application of the internal combustion engine to the road vehicle. The excellent roads hastened its development, and now the motor omnibus is an established feature of continental transportation—one company alone, the London General Omnibus Company, carrying over 2,500,000 people daily. English municipalities are even operating their own bus lines.

In this country, however, the intensive development of the electric trolley in the early days of that industry and its extension into suburban districts provided a means of transportation independent of the highways which was entirely adequate at the time and met every public demand. It supplied transportation for the suburban population otherwise cut off from the cities by impassable roads. Now the suburban trolley no longer satisfies the public need. It fails to tap localities off the beaten line of travel and cannot be extended into new territory because of the prohibitive cost of rights of way, trackage, and overhead construction. Trolley extensions are at a standstill because capital cannot be attracted to the industry. Yet the suburban population is steadily increasing, new residential sections are being developed, and factories are moving outside the city limits—all demanding additional transportation facilities. How is this situation to be met? If new trolley lines cannot be built and the old ones cannot be extended, the only practical solution appears to be the motor bus.

As the traction companies are already in the field with a large capital investment to safeguard, it would be logical for them to operate the busses, not only to increase their business but to forestall competition by independent bus operators who have been quick to see the possibilities of the situation. The traction companies have a valuable ally in the State public service commissions, who have shown on many occasions that they desire to retain the monopoly of city and suburban transportation in the hands of the traction companies; but, although all conditions appear favorable for the successful operation of busses, the traction companies, with a few striking exceptions, have failed to grasp the opportunity and the independent operator is establishing himself as a successful competitor.

Bus service is of two kinds—long haul or interurban and short haul or city—and each kind of service requires different equipment. The Pacific coast has taken the lead in the development of long-distance or interurban transportation. "De luxe" busses

with reclining chairs are now operating between San Francisco and Los Angeles, a continuous trip of 450 miles, which is accomplished in 17 hours, if the passenger desires to make a through trip. If not, stop-over privileges are allowed en route. Similar busses are also operating between San Francisco and Portland. Not only the novelty but also the scenic advantages of the two routes is making a strong appeal to the tourist.

The largest and most profitable field for the development of the motor bus is not, however, in long touring, but in the "short haul" service of our cities and suburbs. Already in several of our



The introduction of the motor bus into city and suburban service will be hastened by the growing seriousness of traffic conditions

large cities the bus has demonstrated its popularity as a means of transportation, and its profitableness as a commercial venture notwithstanding the fact that both the equipment used and the service offered are still in the early stages of development. In the city of Newark, N. J., with 350,000 population, 50,000,000 people rode last year in motor busses of the crudest type. In New York City, the Fifth Avenue Coach Company, with a better type of bus, modelled after the pattern of the London busses, carried last year 52,000,000 passengers at double the fare charged by paralleling



elevated, surface and subway lines. These instances point conclusively to a successful future for the city bus.

The introduction of the motor bus into city service will be hastened by the growing seriousness of traffic conditions. In large cities like New York, Chicago, Philadelphia and Boston the congestion of traffic on the streets is giving traffic officials grave concern, and we are told a radical remedy must be applied before long. It has been suggested that the free movement of traffic would be much improved in congested down-town sections if the trolleys



Good Roads and the motor bus makes for the success of rural school consolidation

are removed entirely and busses substituted in their place. This is a radical remedy, but it has for its foundation the well-known fact that a bus, which is not confined to rails like a trolley car, can wind in and out among other vehicles and will speed up traffic, whereas the trolley car, bound to the rails, slows it down.

Another application of the motor bus which has a particularly important bearing on the welfare of the people, especially the younger generation, is its use to transport children to and from consolidated rural schools. The reason for, and the extent of, the consolidated school movement is not appreciated by the public at large. The one-room country school, so intimately connected with

the early history of our country, is gradually being superseded by the consolidated rural school, housing in one large building the scholars of a number of little school houses.

The educational advantages of this centralization of teaching facilities, the gain by grading the pupils and having one teacher for each grade, instead of one teacher for all grades as formerly, is evident even to the lay public. But the serious obstacle to consolidation, outside the expense of buildings and personnel, has been the lack of transportation facilities.



The motor bus with flanged rims may mean the rehabilitation of numerous short line railroads which cannot now transport passengers except at a considerable loss

If the little school is taken away from the children, they must be carried to the central school, which may be several miles distant. Horse-drawn vehicles are unsuitable because of the long distances to be covered and the exposure to which the children are subjected in bad weather. The motor bus has solved the problem. In fact, consolidation generally will be impracticable without them. To date 14,000 consolidations have been put into effect in the various States and 40,000 more are in contemplation, requiring two to six busses each. The motor bus has a field all its own in the consolidated school movement.



A parallel development of the highway bus has been the "rail bus," a vehicle essentially a highway bus, but with the rubber tires replaced by flanged rims to permit the bus to operate on railroad tracks. The steam roads have found that on lines where the traffic is light a 36-passenger rail car can be operated at about one-tenth the cost of the ordinary steam passenger train, furnishing comparable service. This may mean the rehabilitation of numerous short-line railroads which cannot now transport passengers except at a considerable loss. Here again we see the economic utility of the gas-propelled vehicle, its adaptability and its superiority, within its field, over other means of transportation.

The question is often asked: Will the trolley car be supplanted by the motor bus? Not unless the bus supplies the public with better service at the same fare. By service is meant adherence to schedule in spite of adverse weather conditions, speed between terminals, comfort for the passenger,—which means a seat,—ample ventilation and lighting, and heat in cold weather, cleanliness of equipment, and courtesy from employees. The motor bus has indicated it can supply all this, but the traction companies have nothing to fear if they will regard it as a means of supplementing and extending their service instead of a competitor which must be suppressed by legislative action.

The motor bus, in spite of its present defects, has thoroughly established itself in the favor of the public and cannot now be eliminated. According to the latest statistics, there are 20,000 busses in use in the United States, of which only 131 are operated by the railways. The traction companies, by coordinating street car and bus service, can furnish transportation facilities now lacking. If the companies do not accept the bus there is every indication that its exploitation by independent operators will have a far-reaching effect on the traction industry.

## THE ROMANCE OF ASPHALT HIGHWAYS

By C. W. BAYLISS.

*"Hordes of autos now remind us,  
We should build our roads to stay,  
And departing leave behind us,  
Kinds that rain don't wash away.*

*"When our children pay the mortgage,  
Father made to haul the load,  
They'll not have to ask the question,  
Here's the bond, but where's the road?"*

—CLIPPING.

**F**EW, if any, motorists speeding over the even asphalt highways of the land realize the years of toil and discovery that mark the history of the modern asphalt highway.

The first highway undoubtedly could be traced to Adam. He probably cleared a footpath through the tangled vines of Eden for the fair Eve.

Footpaths were the forerunners of dirt roads and these in turn were harbingers of macadam, and out of the dusty remains of waterbound macadam highways came the modern motor road.

As the centuries passed, each rising generation added to the road builder's knowledge as each generation's mode of transportation differed.

In marked contrast to our modern methods and skill was the system employed by the ancients in hewing a path through undeveloped lands in order to transport their chariots of war or convey the huge stones with which to build their tombs and temples.

Herodotus says that the Egyptians employed 100,000 men for ten years when King Cheops constructed his great highway. It is hard to even imagine this swarming throng of black slaves, beaten and driven under the whips of the Egyptian drivers.

Of all the modern materials used in road building asphalt is oldest. Looking back over the time-stained pages of highway history is found on a Babylonian wall built in 710 B. C. and still in existence, the following inscription referring to the use of asphalt by these ancient road builders:

"Nebuchadnezzar, King of Babylon, he who made Esagla and Ezida glorious, son of Nabopolassar, King of Babylon. The streets of Babylon, the Procession Street of Naby and Marduk, my lords, which Nabopolassar, King of Babylon, the father who begot me, had made a *road glistening with asphalt* and burnt bricks; I, the wise suppliant who fears their



lordships, placed above the *bitumen* and burnt bricks, a mighty superstructure of shining dust, made them strong within with *bitumen and burnt bricks* as a high-lying road."

Asphalt is referred to in many early writings; in fact, some authorities claim that the "pitch" referred to in the biblical account of Noah's construction of the Ark was asphalt.

The asphalt used in the early times was obtained for the most part from small springs or "slime pits" similar to those now in existence in Mesopotamia.



Natives Mining Asphalt in Trinidad Lake

To Christopher Columbus belongs the credit of discovering the great asphalt lake of Trinidad, which lies on the island of that name in the British West Indies.

On the great explorer's third voyage to America in 1498 he discovered the Island of Trinidad. It is interesting to note that he caulked his ships with the same asphalt that now paves the principal cities of the world.

A scant two hundred years later, Sir Walter Raleigh, on his search for the "Eldorado," also visited the asphalt lake of Trinidad and wrote: ". . . It was most excellent good and melteth not in the sun as the pitch of Norway."

For untold centuries Trinidad lake asphalt has been lying under the blaze of the tropic sun, wind and rain. The 114 acres of asphalt have been sun-baked and wind-swept almost since the creation of this planet. Over 4,000,000 tons have been removed, or sufficient to pave a street around the world.

The "seasoning" of this nature-created asphalt is accountable, many engineers say, for the unusual durability of highways built with Trinidad lake asphalt. Many of these thoroughfares are now forty and forty-one years old and are still in splendid condition.

About thirty miles in an air line from the seacoast of Venezuela lies the Bermudez asphalt lake, the second deposit of native lake asphalt, which was also mentioned in the writings of Sir Walter Raleigh.

These two deposits of native lake asphalt have been of inestimable assistance to the road-builder in his struggle to build durable motor roads.

When the waterbound macadam road was perfected, the problem of improved highways appeared to be solved at last. This type of highway adequately met the demands of the slow-moving, horse-drawn vehicle. The fine stone dust ground out by iron tires and tamped into the road by horses' hoofs and wet by rains acted as the cementing agent for the roads, and they remained in excellent condition with occasional repair work.

About the time that the world settled down in the firm belief that its road problem had been settled, a few pioneers devised the automobile, and in a brief span of years MacAdam's perfect highways had been scattered over the adjoining landscape. The rapidly moving pneumatic tires of the motor car sucked the cementing dust from between the stones, and the wind created in the passage of the automobile blew it into the gutters and powdered the fields by the roadside. It became obvious that some agency other than stone dust was necessary to hold our roads together.

Several binding materials were tried out; even molasses was experimented with in the development of the modern bituminous macadam highway. Prior to the advent of the motor car DeSmedt, a Belgian chemist, had been successful in building city pavements out of asphalt imported from Trinidad, B. W. I. This material is the same that is used today to pave the main thoroughfares of the world.

It was natural that the road-building engineer should also turn to Bermudez lake asphalt to solve his problem, as it was easily applied and provided a dustless, resilient and durable highway. Mixed with stone and laid on a cement concrete base, the asphaltic concrete of modern highway practice was developed after years of study and experiment.

Another type of good road is that known as asphalt macadam. One of the best examples of this type of highway is found on the Old Conestoga Road which runs back of the Main Line district just outside of Philadelphia. This highway was constructed about four years ago and has had no maintenance cost to date. The method employed in its building is known as the penetration method. In other words, the Bermudez asphalt was squirted by a pressure distributor into the stone already laid on the road. Asphaltic concrete is made in much the same manner in which our



city streets are built, by mixing the stone with the asphalt and spreading it over the foundation or base while hot.

Unfortunately, the average motorist is not familiar with asphalt and is apt to condemn as asphalt any road black in color that may be worked out. There are many road-building materials, black or gray in color, that are far removed from asphalt.

Most of the lake asphalt used in road construction today is imported from the Bermudez asphalt lake in Venezuela. This deposit and the lake in Trinidad, British West Indies, are the largest and best-known sources of supply of native lake asphalt.



Taunton, Mass., Middleboro Turnpike built with Lake asphalt in 1913  
penetration method, hand poured

In this manner have the avenues of time been paved. The Babylonian, the Egyptian, the Sumarian, the Roman charioteer, the Greek warrior and the motorist of today all have contributed their bit to the romance of asphalt roads.

Tomorrow, if the aeroplane becomes the chief mode of transportation, who knows but our splendid asphalt motor roads will fade into footpaths of the past?

It is a distant "tomorrow," however, that pictures such a spectacle, for it is almost inconceivable to believe that man will ever entirely supplant the automobile by the aeroplane, and just so long as motor transportation remains our highways must be built and maintained to support them.

## HIGHWAY FINANCING AND TAXATION

By M. O. ELDREDGE

*A.A.A. Director of Roads*

**H**IGHWAY construction and maintenance funds available for expenditure in the United States during 1922, exclusive of city streets, amount in round numbers to about \$680,000,000, an increase of about \$53,000,000, or about 8.5 per cent over corresponding figures for last year.

This amount is made up as follows: Federal aid, \$125,000,000 which includes \$75,000,000 appropriated by Congress for the year and accumulations from previous appropriations; State funds derived from various sources, \$275,000,000; county and local funds, \$271,000,000. In view of the depressing financial condition through which the country has passed during recent months this is a rather encouraging sign and indicates that a determined effort is being made in most of the States to solve the highway transportation problem and at the same time to provide employment for many of the millions of men who are now out of work.

### Funds for State Highway Purposes

The Federal Highway Act, approved November 9, 1921, provided that hereafter the States shall furnish the money with which to meet Federal aid or that they shall have complete control over the funds thus used. A review of the financial situation from the standpoint of State funds may therefore be not amiss.

As above indicated, the State funds available for 1922 to meet Federal aid and local contributions amount approximately to \$275,000,000, an increase of about \$43,000,000 or 19 per cent more than was available from the same sources during 1921.

These funds were derived first, from special or general State-wide taxes; second, legislative appropriations from special or regular funds; third, State bonds; fourth, automobile revenues and fifth, gasoline taxes and other special funds.

A State-wide highway tax varying from 1/10 to 3½ mills on the dollar is now levied in twenty-five States, yielding approximately \$21,000,000 which is a decrease over receipts from last year of about \$15,000,000.

Annual appropriations from general or statutory funds for State or State aid road work and to meet Federal aid are made by the legislatures in sixteen States. The amount available from this



STATE HIGHWAY FUNDS—SOURCE AND APPROXIMATE AMOUNTS ANNUALLY AVAILABLE EXCLUSIVE OF FEDERAL AND COUNTY FUNDS

STATES	STATE WIDE TAX		Legislative Appropriation 1921 or 1922	STATE ROAD BONDS		MOTOR VEHICLE FUND		SPECIAL FUNDS	TOTALS
	Rate Mills Per \$1	Estimated Annual Receipts		Total Recent Issues	Estimated Amount Available 1922	Percentage	Annual Amount Available	Source and Amount 1922	
Alabama.....	1/2	\$ 400,000	.....	\$ 25,000,000	\$ 2,500,000	77 1/2	\$ 1,100,000	\$ 150,000(g)	\$ 3,600,000
Arizona.....	.....	.....	.....	.....	.....	All net	200,000	335,000(g)	750,000
Arkansas.....	.....	.....	.....	40,000,000	12,000,000	30	300,000	.....	635,000
California.....	1	1,578,256	.....	5,000,000	3,000,000	50	457,532	Int. imp. \$50,000	15,500,000
Colorado.....	.....	.....	.....	.....	.....	50	.....	50% 365,000(g)	5,451,188
Connecticut.....	.....	.....	\$ 2,093,250	.....	.....	All net	2,500,000	685,000(g)	5,278,250
Delaware.....	.....	.....	.....	.....	1,400,000	All net	475,000(b)	300,000	2,175,000
District of Columbia.....	.....	.....	969,840	.....	.....	.....	.....	DuPont Fund	969,840
Florida.....	1	475,000	.....	.....	.....	All net	800,000	680,000(g)	1,955,000
Georgia.....	.....	.....	.....	.....	.....	All net	1,800,000	660,000(g)	2,460,000
Idaho.....	9/10	450,000	.....	2,000,000	2,000,000	25	150,000	.....	2,600,000
Illinois.....	.....	.....	.....	60,000,000	28,000,000	All net	6,800,000	.....	34,800,000
Indiana.....	33/100	2,250,000	.....	.....	.....	All net	2,500,000	750,000	5,500,000
Iowa.....	.....	.....	.....	.....	.....	All net	8,000,000	Inheritance	8,000,000
Kansas.....	.....	.....	.....	.....	.....	All over 50c.	3,000,000	.....	3,000,000
Kentucky.....	3/10	670,000	.....	.....	.....	All net	2,000,000	375,000(g)	3,045,000
Louisiana.....	.....	.....	.....	.....	.....	All net	1,750,000	750,000(g)	2,500,000
Maine.....	.....	637,403	300,000	6,264,500	1,250,000	All net	1,022,791	.....	3,210,194
Maryland.....	3 1/2 (b)	.....	.....	3,000,000	1,500,000	80	1,700,000	.....	3,200,000
Massachusetts.....	.....	.....	2,390,000	.....	.....	All net	4,385,000	.....	6,775,000
Michigan.....	.....	.....	.....	50,000,000	10,000,000	50	3,000,000	.....	13,000,000
Minnesota.....	1	1,775,000	.....	75,000,000(f)	.....	All net	6,000,000	.....	7,775,000
Mississippi.....	.....	.....	100,000	.....	.....	All net	2,100,000(c)	.....	760,000
Missouri.....	.....	.....	798,000	60,000,000	10,000,000	All net	2,100,000	.....	12,898,000
Montana.....	.....	.....	.....	.....	.....	50	275,000	294,000(g)	3,516,000
Nebraska.....	3 (a)	.....	1,416,000	.....	.....	75	.....	.....	3,509,000
Nevada.....	2	385,000	.....	1,000,000	350,000	All net	1,000,000	.....	1,735,000
New Hampshire.....	.....	.....	200,000	.....	.....	All net	1,000,000	.....	1,000,000
New Jersey.....	1	3,500,000	.....	.....	.....	60	3,500,000	.....	6,800,000
New Mexico.....	3 1/2	1,400,000	.....	2,000,000	2,000,000	All net	200,000	80,000(g)	3,680,000
New York.....	.....	.....	13,645,628	.....	.....	75	(c)	.....	13,645,628

STATE HIGHWAY FUNDS—SOURCE AND APPROXIMATE AMOUNTS ANNUALLY AVAILABLE EXCLUSIVE OF FEDERAL AND COUNTY FUNDS—Continued

STATES	STATE WIDE TAX		Legislative Appropriation 1921 or 1922	STATE ROAD BONDS		MOTOR VEHICLE FUND		SPECIAL FUNDS	TOTALS
	Rate Mills Per \$1	Estimated Annual Receipts		Total Recent Issues	Estimated Amount Avail- able 1922	Percentage	Annual Amount Available	Source and Amount 1922	
North Carolina.....				50,000,000	10,000,000	All net	3,000,000	743,000(g)	13,743,000
North Dakota.....						50	350,000		350,000
Ohio.....	$\frac{1}{2}$	400,000	5,000,000			All net	3,500,000		8,500,000
Oklahoma.....	$\frac{1}{2}$	1,000,000				75	2,500,000		2,900,000
Oregon.....	1		6,500,000	10,000,000	7,500,000	All net	1,500,000	1,000,000(h)	11,000,000
Pennsylvania.....	$\frac{3}{10}$	300,000	310,000	50,000,000		All net	9,500,000	3,448,000(g)	19,448,000
Rhode Island.....	2	1,000,000				All net	850,000		1,460,000
South Carolina.....	$\frac{1}{10}$	210,000				All net	800,000		1,800,000
South Dakota.....	$\frac{1}{10}$	900,000		6,000,000	1,000,000	All net	250,000	596,000(g)	2,056,000
Tennessee.....	$\frac{55}{100}$					All net	1,600,000		2,500,000
Texas.....						50	2,000,000		2,000,000
Utah.....	$\frac{1}{2}$	307,000			191,000	(e)	550,000		498,000
Vermont.....	$\frac{1}{2}$	150,000	260,000			75	2,100,000		960,000
Virginia.....	$\frac{1}{2}$	1,700,000	700,000			All net	2,925,730	400,000(d)	4,900,000
Washington.....	1		1,200,000			All net	2,925,730	927,000(g)	5,032,730
West Virginia.....				50,000,000	15,000,000	All net	1,175,365		16,175,365
Wisconsin.....	$\frac{4}{10}$	1,700,000				75	2,835,000		4,535,000
Wyoming.....			200,000	1,000,000	1,000,000	(e)			1,200,000
Totals.....		\$21,187,659	\$36,082,718	\$496,264,500	\$108,691,000		\$96,511,818	\$12,558,000	\$275,031,195

- (a) Appropriation from.  
 (b) Proceeds used for retirement of State bonds.  
 (c) By legislative appropriation only.  
 (d) Value of prison labor.  
 (e) Receipts used for retirement of State bonds.  
 (f) Authorized but not issued.  
 (g) Gasoline tax 1c. per gallon.  
 (h) Gasoline tax of 2c. per gallon.



source during 1922 is approximately \$36,000,000 which is about \$5,000,000 less than was appropriated for last year.

Funds derived from State road bond issues in eighteen States available for expenditure in 1922, amount to \$108,700,000 which is an increase of about \$43,000,000 over last year.

The total recent bond issues or authorizations for bond issues amount to approximately \$496,300,000. Recent county issues amount to about \$500,000,000. This money will be spread over a period of years.

### Motor Vehicle Funds

In all of the States the revenues derived from the registration of motor vehicles, which now amounts to about \$122,000,000 a year, is used in whole or in part for State or State aid road purposes.

In twenty-eight States the net receipts from registrations are utilized by the State highway departments, mainly for the maintenance of State and Federal aid roads. From twenty-five to seventy-five per cent of the registration receipts are retained or returned to the counties or municipalities in twenty States. In some cases this money is judiciously expended mainly for maintenance of the more important roads but as a general rule the money thus returned or retained is wasted.

The total amount available to the States from this source for 1922 will be approximately \$96,500,000 exclusive of that portion of these funds which is returned or retained by the counties and municipalities from which the taxes are collected. This is an increase of about \$12,000,000 over last year's figures.

Personal property taxes, amounting to about \$5,000,000 a year, are levied against automobiles in thirty-eight States, but this money is retained by the municipalities and counties collecting it for general expenses and is thus lost to road improvement except insofar as local funds are drawn upon for that purpose.

During 1921 there were only four States in which a gasoline tax was collected. There are now fifteen States collecting a gasoline tax and from this source the approximate receipts will amount to about \$12,500,000 in 1922. This tax is not in lieu of but in addition to other motor vehicle taxes.

A new development in the gasoline tax situation has grown out of a suggestion made in the State of Washington last fall. In view of the contention of car owners that a gasoline tax constitutes an extra burden, the suggestion was made that the license fee for motor cars be reduced to a nominal sum and that a gasoline tax be levied which would be equivalent to the registration fee thus placing the tax burden of the automobile in proportion to its use of the highways. By this plan, it was suggested that the reg-

istration fee could be reduced to a minimum, the charge made being barely sufficient to cover the cost of license plates and registration. It was also suggested that if this plan were adopted it would eliminate the vexatious problem of duplicating registrations between States as the bulk of taxes would then be paid by the car owners in the States over which they happen to be operating.

This plan of gasoline taxation has been embodied in two laws recently passed by the legislature of Maryland. One provides for a tax of 1 cent per gallon for a preliminary period of about twelve months in order to make up a deficiency in the State maintenance fund and to determine the amount of money which it will be possible to collect from this source after which the other law provides for a tax of 2 cents a gallon will be levied and the horsepower tax reduced by a corresponding amount. The Maryland law also carries a proviso that when the 2-cent rate goes into effect the governor may arrange for complete reciprocity with the District of Columbia.

There is an appalling lack of uniformity in motor vehicle taxation in the different States and consequently an urgent need for some simple form of single taxation which will be less burdensome and obnoxious to the taxpayer and less troublesome and expensive to the tax collector; and at the same time a tax which will render fair and just return to the public treasury in proportion to the service rendered by the highways.

The need for uniformity is shown by the fact that in the forty-eight States there are now seventeen different bases or combinations of motor vehicle taxes. In several States there are two or more taxes and in one State—for fear of missing something—the motor vehicle is taxed in four different ways, namely: cost of vehicle, weight unloaded, horsepower and carrying capacity.

For a number of years, the general tendency has been to devote an ever increasing portion of the motor vehicle revenue to road work under the control and direct supervision of the State highway departments. Prior to 1912, only a very small portion of this money was devoted to road purposes. In 1920, 76 per cent of the registration revenue or about \$77,500,000 was applied to road work under State supervision but during 1922 it is expected that this fund will amount, as above indicated, to over \$96,000,000.

In most of the States the motor vehicle funds are devoted to maintenance and repair of State roads or other improved highways. These States seem to have solved the difficult problem of securing adequate funds for the maintenance of the more important roads under the ever increasing motor vehicle traffic requirements.

In a number of States which have in general but a small mileage of improved highways, there has been adopted the plan of capitalizing the motor vehicle revenues and devoting the whole or a large



portion of these funds to construction. States in which this plan has been adopted are, Alabama, Illinois, Maine, Missouri, Nevada, Utah and Wyoming. In these States, bonds have been voted for road construction. In some cases the interest as well as the principal is to be paid from the motor vehicle revenue.

There are a few States, including Arkansas, Montana, North Dakota, Texas, Georgia, Iowa, Louisiana, in which the sole revenue for State highway purposes is derived from motor vehicle registration fees or gasoline taxation.

From the above, it will be seen that the motor vehicle owners of the country are carrying a considerable share of the tax burden for road improvement. In view of their willingness in most States to be thus taxed, there has recently grown up a tendency on the part of lawmakers to greatly increase the motor vehicle taxes and some of the legislators go so far as to insist that the car owners should bear the entire burden of public highway financing, especially for State highways.

In the recent protest to Congress against placing one-third of the cost of the soldier bonus on the car owners of the country by means of a registration and gasoline tax, the point was made by the A.A.A. that automobile owners are already heavily taxed and are spending their money freely in improving the highways of the various States. This discussion brought out the fact that motor vehicle taxation in the United States now amounts to about \$335,000,000 a year.

During 1922 this figure will probably reach \$350,000,000, or, in other words, will be equivalent to about one-half of the amount which is to be spent by the national, State and local governments for highway construction and maintenance during the year. This amount includes Federal excise taxes paid by the manufacturer and passed on to car owners amounting to \$116,000,000 a year, an amount more than \$40,000,000 in excess of the \$75,000,000 appropriated for Federal aid to highways for the fiscal year 1923.

It would seem, therefore, that the logical answer to this demand for more money, so urgently needed for modern highways throughout the country in the shortest possible time, is to provide legislation which will place the bulk of all motor vehicle taxes now collected in registration fees, gasoline, property, excise, franchise and other forms of taxation into highway improvement funds and to require that these funds shall not be used for any other purpose.

Inasmuch as all property owners share in the benefits of road improvement whether they own automobiles or not, it would seem only fair that they also should share in the cost. The shifting of the whole cost of any highway or any system of highways to the shoulders of the owners of motor vehicles would appear to be as unjust as to require only the fathers of families to pay the entire cost of maintaining the public school system of the nation.

## EDUCATION FOR HIGHWAY ENGINEERING AND HIGHWAY TRANSPORT

By WALTON C. JOHN,

*Secretary, Highway and Highway Transport Education Committee, and Specialist in Rural and Technical Education, U. S. Bureau of Education.*

THE impetus which the world war gave to highway construction has been reflected in the amount of attention given by Federal and State highway authorities to the increase and improvement of their personnel.

Highway engineering until recently in many ways was considered more as an art than a science which developed parallel with certain principles and practices connected with railroad building. Today the volume and character of motor-driven traffic has rendered obsolete much of the so-called science of road building. For that reason schools of engineering have been obliged to reconsider the entire educational program regarding the training of highway engineers. And only in very recent years has attention been focused on the importance of highway transport in its relation both to highway engineering and highway economics.

With this objective in mind, the former Commissioner of Education, Dr. Philander P. Claxton, was requested by the leaders in both the highway engineering and highway transport fields of endeavor to call a national conference in Washington to study the new problems which were demanding immediate solution. This conference met on May 14-15, 1920, and was attended by nearly one hundred leaders among Federal and State highway authorities, heads and representatives of the automotive industry, teachers of highway engineering and highway transport, and representatives of other organizations. The conference was organized into four general committees as follows: Highway Engineering, Highway Transport, Research, and Resolutions.

The committee on highway engineering encouraged the further cooperation of colleges and highway commissions; it also recommended that the giving of short courses in highway engineering by colleges for county road officers be encouraged; and that the college course of instruction for highway engineers give especial attention to the fundamentals relating to modern life: likewise suggestions were made regarding suitable highway options to reflect special needs. Undergraduate students in highway engineering were to be encouraged to learn something of the methods and



standards of research in order to prepare themselves for future work in that field.

The committee on highway transport recommended that universities and colleges offer courses in highway transport as their facilities might permit, and that at least ten universities, located in different geographical sections of the United States, should offer short advanced courses covering various phases of highway transport; and four year courses in highway engineering; or highway transport options in four year collegiate or technical courses. It was recommended that the underlying principles of highway engineering, highways and highway transport, as well as rules of the road, be taught in grammar and high schools of the country, and that preparatory vocational guidance be given in the grammar and high schools of the country with particular reference to the professions of highway engineering and highway transport.



Highway and Highway Transport Education Committee

The committee on research recommended that a moderate number of colleges and universities, properly equipped, should be urged to undertake research in highway engineering and highway transport, and that this research should be directed by some central authority, and that sufficient funds should be raised and placed in charge of this central authority to carry on research for the purpose of prompting cooperation with different agencies throughout the country; that the national Government be urged to likewise appropriate generously for work in the aforementioned fields; that each State appropriate a definite portion of the funds appropriated for highway construction for the prosecution of research in highway engineering and highway transport; and that State highway departments should seek the cooperation of colleges and universities and experiment stations in solving research problems peculiar to the State concerned. Recommendations also were

made regarding strengthening the business training of students in highway engineering and highway transport.

The committee on resolutions recommended among other things the appointment of a permanent committee to carry out the program suggested at the conference. Consequently, in harmony with the recommendations, former Commissioner P. P. Claxton on May 28, 1920, appointed the committee, naming representatives from the following organizations: United States Bureau of Public Roads; United States War Department; National Automobile Chamber of Commerce; Rubber Association of America; The American Association of State Highway Officials; Society for the Promotion of Engineering Education. At a recent date a representative from the Society of Automotive Engineers was added. The present personnel of the committee is as follows:

John J. Tigert, chairman, U. S. Commissioner of Education.

Thomas H. MacDonald, chief, Bureau of Public Roads, Dept. of Agriculture.

Roy D. Chapin, President Hudson Motor Car Company, Vice-President, National Automobile Chamber of Commerce.

Harvey S. Firestone, President, Firestone Tire & Rubber Co., representing the Rubber Association of America.

Col. F. C. Boggs, Corps of Engineers, U. S. Army, War Department.

F. L. Bishop, Dean, School of Engineering, University of Pittsburgh, Secretary of the Society for the Promotion of Engineering Education.

H. W. Alden, Vice-President, Timken-Detroit Axle Co., representing the Society of Automotive Engineers.

The committee chose as director, Professor C. J. Tilden, Head of the Department of Engineering Mechanics of Yale University, who was released from the university for a period of eight months.

### **New Data on Highway Engineering and Highway Economics**

Various agencies have contributed during the last year to the fields of highway education and research. These studies and investigations may be considered the basis of a new science of highway transport. Notable among these are the contributions of the Bureau of Public Roads which has made careful investigation of materials under diverse conditions. Studies have been made in land values in relation to improved highways, in addition to traffic census studies at the University of Wisconsin. The University of Tennessee has investigated relative traffic conditions in three typical counties of the State of Tennessee. The University of Maryland has also made important studies of traffic loads as well as volume of traffic in the State of Maryland. Other important projects are being carried on through the War Department in addition to other agencies too numerous to mention.



### National Research Council

During the past year Dr. W. K. Hatt, Professor of Civil Engineering at Purdue University, was named director of the Highways Advisory Board of the Engineering Section of the National Research Council. The coordination of research in highway engineering and cognate subjects in the leading colleges throughout the country will doubtless prove to be of great importance to the science of highway development.

### Course in Highway Transport

One of the most pressing needs was the preparation of a course of study on the economics of highway transport, based upon scientific data. After careful study, and collaboration with leading authorities of the country, Mr. Lewis W. McIntyre, Assistant Professor of Civil Engineering, University of Pittsburgh, prepared a valuable contribution which has just been published under the direction of the Highway and Highway Transport Education Committee.

### Regional Conferences

In order further to stimulate intelligent thought and action in the country, eight regional conferences have been held in different parts of the United States as follows:

University of Pittsburgh.  
University of Michigan.  
University of Missouri.  
University of Maryland.  
Yale University.  
University of Tennessee.  
University of Kentucky, and  
Agricultural and Mechanical College of Texas.

These conferences have succeeded in a measure in bringing together the several interests in the respective States to discuss the educational policies involved in a far-seeing modern highway and highway transport engineering program. Improvement has been made in the highway engineering courses locally and increased support has been given to research as a result of these conferences.

### Scholarships and Educational Contests

The committee conducts two national contests in the public schools of the country. The first is known as the Harvey S. Firestone University Scholarship which is offered for the best essay on a subject pertaining to highway economics. In addition to the State awards, the winner of the national prize is awarded, through the generosity of Mr. Firestone, a four year's university scholarship, valued at \$4,000. During the past two years these contests have reached approximately half a million high school students. The winner of the 1920 scholarship was Miss Katharine Butterfield, of Weiser, Idaho, who is now attending the Northwestern University, Evanston, Illinois. The winner of the 1921 prize was Miss Garland Johnson, of Bridgeport, West Virginia, who has just completed her junior year in high school.

The value of the Firestone scholarship essay contests rests on the fact that it stimulates the young men and women who are about to become voters to study and comprehend one of the largest and most important economic questions that the country has to deal with.

The committee on awards of the Firestone scholarship foundation for 1921 were Dean A. N. Johnson, School of Engineering, University of

Maryland; Harford Powel, Jr., Editor of *Collier's Weekly*; and C. H. Huston, Assistant Secretary of the U. S. Department of Commerce.

In addition to the good roads contest the committee offered in 1921, through the generosity of the National Automobile Chamber of Commerce, two Safety contests. The first is a contest open to boys and girls 14 years of age and under, of elementary school grade, for the best essay on "How I Can Help to Make the Highways More Safe." Participants in this contest numbered at least 500,000 children. In addition to a national prize, which includes for the winner a gold watch and a trip to Washington, 472 first, second and third prizes are offered in the several States.

Likewise, elementary school teachers were offered three prizes for the best lessons on the teaching of safety in the elementary schools. The first prize of \$500 in cash and a trip to Washington. The second and third prizes are \$300 and \$200 respectively.

The committee on awards for the national safety essay contest are as follows: Mrs. Warren G. Harding, Honorary Chairman; Senator Coleman duPont of Delaware, chairman; Mrs. John Dickinson Sherman, chairman of the Committee of Applied Education, General Federation of Women's Clubs; Dr. William T. Bawden, assistant to the United States Commissioner of Education.

The committee on awards for the national lesson contest on safety are Mr. William P. Eno, President of the Eno Foundation for the Regulation of Highway Traffic, Inc., chairman; Dr. Thomas E. Finegan, Commissioner of Education. State of Pennsylvania; W. J. Funk, Vice-President, Funk and Wagnalls Company, publishers *Literary Digest*.

Four University Fellowships in highway engineering and highway transport are offered annually by the University of Michigan, as follows:

*The Roy D. Chapin Fellowship in Highway Transport*, which is offered to provide for the investigation of an approved subject relative to highway transport.

*The Roy D. Chapin Fellowship in Highway Engineering*, which is offered to provide for the investigation of an approved subject relative to hard surfaced road and pavements.

*Two Detroit Edison Fellowships in Highway Engineering*, which are offered to provide for the investigation of approved subjects relative to moderate cost country roads.

Each Fellowship pays the sum of \$250 with an allowance of \$50 for expenses. The holders of these Fellowships do not have to pay tuition fees. A Fellow must hold a Bachelor's Degree from a college of recognized standing. He must enroll as a graduate student in highway engineering or highway transport and as a candidate for the degree of Master of Science or Master of Science in Engineering.

### Highway Transport and Consolidated Schools

The Bureau of Education has been carefully investigating the relation of transportation to the establishment and development of consolidated schools. The consolidated school scarcely can exist today unless it has improved roads and improved means of transportation available.

The committee is developing a definite program regarding the teaching of safety in the public schools at the request of State and city school officers. It is hoped that the extension of safety teaching in conjunction with the safety essay contests will result in an actual decrease in motor accidents. The fact that an appalling number of school children are killed annually in traffic mishaps requires action on the part of educational authorities to correct this evil.



### **Enrollments of Highway Engineers in Colleges of Engineering**

In the accompanying table the enrollments of four-year students in Civil Engineering, the enrollments in the senior classes and the number of those specializing in highway engineering are recorded for the year 1921-22. According to this table there are 8,709 students the majority of which are preparing in Civil Engineering. Of these 1,870 are members of the senior class, more than one-fourth of which have already indicated their desire to specialize in highway engineering, the number being 503. The latter number, however, by no means indicates the extent of specialization which may be expected from the senior classes in the highway engineering field, inasmuch as only 48 out of the 114 schools which have reported permit or indicate specialization in highway engineering.

### **Colleges and Universities Offering Courses in Highway Engineering, 1921-22**

In the following table is found the names of the colleges and universities offering specific courses in highway engineering with a brief statement as to the nature of these courses. In order to avoid too lengthy a statement courses in surveying and other fundamental courses which are required of highway engineering students in the Civil Engineering curriculum are not listed.

Name of Institution	4 Year Students in Civil Engineering	Number in Senior Class	Number Special- izing in High- way Engineering
Alabama Polytechnic Institute <sup>1</sup>	94	19	6
University of Alabama	29	3	
University of Arizona	37	4	
University of Arkansas	19	9	
University of California		19	
University of Santa Clara, California	12	1	
California Institute of Technology	70	14	3 <sup>2</sup>
University of Southern California	3	5	
The Colorado State Agricultural College	150	15	10
University of Colorado	125	15	
Colorado College	24	3	
Yale University	26	12	
Delaware College	25	3	
Howard University, D. C.	13	2	2
George Washington University, D. C.	103	5	
Catholic University of America, D. C.	28	7	
University of Florida	2	2	
Georgia School of Technology, Atlanta	32	36	
College of Hawaii	39	6	2
University of Idaho	34	6	
University of Illinois	336	65	17
Armour Institute of Technology, Chicago, Ill.	151	18	10
Purdue University, Lafayette, Ind.	397	69	15
University of Notre Dame, Notre Dame, Ind.	61	12	
Rose Polytechnic Institute, Indiana	33	8	5
Valparaiso University, Indiana	70	24	
Iowa State College of A. & M. Arts	300	42	8
University of Iowa	110	26	
Kansas State Agricultural College	152	12	7
University of Kansas	25	26	4
University of Kentucky	90	15	5
Louisiana University and A. & M. College	4	5	4
University of Maine	97	24	11
The Johns Hopkins University	55	8	
University of Maryland		4	4
Tufts College, Mass.	122	44	22
Northeastern College, Boston	196	23	5
Worcester Polytechnic Institute	47	19	
Harvard University	49	14	
Massachusetts Institute of Technology	90	20	16
University of Michigan	322	89	109 <sup>3</sup>
University of Detroit	40		
Michigan Agricultural College	146	25	7
University of Minnesota	270	43	
Mississippi A. & M. College	32	12	

<sup>1</sup> Four year course on Highway Engineering established.<sup>2</sup> Favor a career.<sup>3</sup> Includes 94 in graduate short course, 23 who will receive Masters degree in June.



Name of Institution	4 Year Students in Civil Engineering	Number in Senior Class	Number Special- izing in High- way Engineering
University of Mississippi.....	42	11	6 <sup>1</sup>
University of Missouri.....	126	15	.....
Washington University, St. Louis, Mo.....	<sup>a</sup>	13	2
Montana State College.....	6	6	3
University of Nebraska.....	160	29	15
University of Nevada.....	18	2	.....
Dartmouth College; Thayer School of C. E.; Hanover, N. H.....	.....	7	<sup>a</sup>
Rutgers College and State University of New Jersey.....	70	10	3
Princeton University.....	88	23	.....
University of New Mexico.....	12	.....	.....
New Mexico College of A. and M. Arts.....	7	2	1
Columbia University, N. Y.....	8 <sup>4</sup>	3	.....
New York University.....	68	17	.....
Manhattan College.....	56	10	.....
Union University, N. Y.....	20	20	.....
Cornell University, N. Y.....	225 <sup>4</sup>	78	12
Polytechnic Institute of Brooklyn.....	60	16	5
Syracuse University.....	65	11	.....
Rensselaer Polytechnic Institute.....	327	95	.....
Clarkson College of Technology, N. Y.....	27	7	.....
North Carolina State College of Agriculture and Engineering.....	148	28	20
North Dakota Agricultural College.....	28	2	.....
University of North Dakota.....	30	2	.....
Ohio Northern University.....	116	27	.....
Case School of Applied Science, Cleveland, Ohio	50	18	.....
University of Dayton, Ohio.....	12	.....	.....
Municipal University of Akron.....	48	1	.....
University of Cincinnati.....	.....	25	.....
Ohio State University.....	232	38	5
University of Oklahoma.....	7	7	5
Oklahoma A. and M. College.....	47	1	1
Oregon Agricultural College.....	165	22	1
Lehigh University, Pa.....	125	26	<sup>6</sup>
Carnegie Institute of Technology.....	62	16	.....
Bucknell University, Pa.....	51	10	.....
Villanova College, Villanova, Pa.....	34	4	.....
Lafayette College, Easton, Pa.....	46	10	.....
Pennsylvania College, Gettysburg.....	34	5	2
University of Pittsburgh.....	50	8	4

<sup>1</sup> Favor a career.<sup>2</sup> C. E. Students not separated until Sophomore year.<sup>3</sup> Number students specializing not indicated.<sup>4</sup> 6 year students.<sup>5</sup> Does not include 100 freshmen.<sup>6</sup> 2 or 3 will probably choose career.

Name of Institution	4 Year Students in Civil Engineering	Number in Senior Class	Number Special- izing in High- way Engineering
Pennsylvania State College.....	188	43	35
University of Pennsylvania.....	146	38	.....
Drexel Institute, Philadelphia.....	.....	9	.....
Brown University, R. I.....	50	4	2
Rhode Island State College.....	18 <sup>1</sup>	4	.....
Swarthmore College.....	14	2	1
The Citadel, S. C.....	64	30	6
Clemson Agricultural College, S. C.....	85	21	11
University of South Carolina.....	48	11	5
University of South Dakota.....	25	5	.....
South Dakota State College.....	8	8	8
South Dakota State School of Mines.....	55	3	1
University of Tennessee.....	6	6	2
University of Texas.....	12	12	8
Tulane University of Louisiana.....	46	7	.....
Rice Institute, Houston, Texas.....	52	10	3
A. and M. College of Texas.....	238	36	20
University of Utah.....	10	10	.....
University of Vermont and State Agricultural College.....	58	9	.....
Norwich University, Vt.....	22	22	4
Virginia Polytechnic Institute.....	75	15	7
Virginia Military Institute.....	31 <sup>2</sup>	14	.....
University of Virginia.....	188	40	.....
Washington and Lee University.....	32	2	.....
State College of Washington.....	49	2	2
University of Washington.....	15	16	6
West Virginia University.....	88	9	7
Marquette University, Wisconsin.....	302 <sup>3</sup>	16	.....
University of Wisconsin.....	30	30	10
University of Wyoming.....	24	3	.....
	8709 <sup>4</sup>	1870	503

<sup>1</sup> Plus an undetermined part of the freshman engineering class.

<sup>2</sup> Students not separated until Junior year.

<sup>3</sup> 5 year students.

<sup>4</sup> This total includes a small proportion of those who have not chosen their specialty.



### Institutions, Names of Courses, and Time Allotted to Each Course<sup>1</sup>

Alabama Polytechnic Institute, Auburn—Highway engineering, junior 1st, 2d, 3d terms, 3 hours; highway engineering, laboratory, junior 1st, 2d, 3d terms, 2 hours a week; highway engineering, senior 1st, 2d, 3d terms, 3 hours a week.

University of Alabama, University—Highway engineering, 2 hours' credit, first half-year; roads and pavements, 3 hours' credit, second half-year.

University of Arizona, Tucson—Materials testing, one to three hour laboratory periods, one to three units; highway engineering, 2d semester, two recitations, two units.

University of Arkansas, Fayetteville—Highways, 2 hours a week; highway engineering, 3 hours a week; highway engineering, laboratory, 3 credit hours a week (six hours); bridge design, 2 hours a week; advanced bridge design, 3 hours a week.

University of California, Berkeley—Highway engineering, 2 hours first half-year; civil engineering, laboratory, 3 hours with outside work first half-year, 2 units; civil engineering, laboratory, 3 hours second half-year, 1 unit.

University of Southern California, Los Angeles—Highway engineering, 2 units, 2d semester.

California Institute of Technology, Pasadena, Calif.—Highway engineering, 3d term, junior year, 5 units.

University of Santa Clara, Santa Clara, Calif.—Materials, testing, laboratory, 1 credit, 2 hours, laboratory, 1st semester; roads and pavements, 2 credits, 2 hours, 1st semester.

University of Colorado, Boulder—Roads and pavements, autumn quarter, 3 hours lecture, 3 hours laboratory.

The Colorado State Agricultural College, Fort Collins—Course in highway engineering requires 160 credits and includes: mechanics of materials, 5 credits; design, 5; drainage, 2; contracts and specifications, 2; surveying, 13; hydraulics, 5; trusses and bridges, 5; highway engineering and road materials, laboratory, 5; concrete construction and concrete, laboratory, 4; cost data, 2.

Colorado College, Colorado Springs—Roads, pavements and parks, 2d half senior year, 2 hours' credit; testing laboratory, 2d half-year, one 3-hour laboratory period a week, 2 hours' credit; temporarily suspended.

Yale University, Sheffield Scientific School, New Haven, Conn.—Highway engineering, 3d year civil engineering, 2d term, 2 recitations, 1 lecture and 1 hour of applied work with 3 hours of outside work and inspection trips and reports per week.

Delaware College, Newark, Del.—Recitations, 2 hours, second term; laboratory in road materials, 3 hours, second term; 2d term, one-half year; senior year.

George Washington University, Washington, D. C.—Highways and pavements, 2 hours a week, 4 semester hour credits.

Catholic University of America, Washington, D. C.—Highway engineering, lectures, recitations and field work, 3 hours per week first half-year.

Howard University, Washington, D. C.—Roads and pavements, sophomores, 5 lecture-recitations and 3 hours of field work per week, winter.

University of Florida, Gainesville—Highway engineering, recitations, 2 hours a week; field work, 3 hours a week, 2d semester.

University of Georgia, Athens—Highway engineering, 3 hours per week, junior year.

<sup>1</sup> Compiled by the United States Bureau of Education.

Georgia School of Technology, Atlanta—Highway engineering, 1st term, junior, 1 hour lecture; 2d term, junior, 3 hours laboratory; 1st term, senior, 2 lectures, 3 hours laboratory; 2d term, senior, 3 lectures, 3 hours laboratory.

College of Hawaii, Honolulu—Concrete and masonry structures, 2d semester, 3 credits; bridge design, 2d semester, 3 credits.

University of Idaho, Moscow—Roads and pavements, 3 credits, 1st semester; road materials, laboratory, C. E. Lab. course, 2 credits each semester in the junior year.

Armour Institute of Technology, Chicago, Ill.—Highway engineering, 5 hours per week, 1st half of first semester; senior year, course in civil engineering. Elective: Highway engineering, 5 hours per week, second semester of senior year. Plain and reinforced cement, 5 hours per week, 1st semester of junior year.

University of Illinois, Urbana—Roads and pavements, 4 semester hours; highway design, 3 semester hours; highway administration, 3 semester hours; road materials, 2 semester hours; highway construction; course for graduates, twice a week, 1 unit, 3 semester hours.

Purdue University, Lafayette, Ind.—Highway construction, juniors, 1st semester. A study of the design, construction and maintenance of earth, sand clay, gravel, broken stone, brick, concrete, granite and wood-block roads and streets. Second semester, a study of bituminous materials, and of the design, construction and maintenance of bituminous roads and streets. Highway design, seniors, optional 1st semester. Highway administration and finance, 2d semester.

University of Notre Dame, Notre Dame, Ind.—Roads and pavements, 4 hours a week for one term.

Valparaiso University, Valparaiso, Ind.—Municipal engineering, 3 years of 3 quarters each averaging 13 hours per week, 5 hours recitation, 8 hours drafting and field work. Highway engineering included, occupies about 1 year of 3 quarters, averaging 4 hours recitation, 8 hours drafting and field work.

Iowa State College of Agriculture and Mechanic Arts—Ames, Roads and Pavements, Fall, 3 recitations per week (for Agricultural Engineers), 3 credits; winter, 5 recitations per week (for Civil Engineers), 5 credits; highway design, spring, 1 recitation, two 3-hour laboratory periods per week, 3 credits; highway bridges, fall, 1 recitation, two 3-hour laboratory periods per week, 3 credits; road material testing, fall, 1 recitation, three 3-hour laboratory periods per week, 4 credits; highway administration, winter, 3 recitations per week, 3 credits; highway specifications, spring, 3 recitations per week, 3 credits; highway transport, fall, 3 recitations per week, 3 credits; highway engineering graduate courses in highway transport, transportation economics, specification writing, highway jurisprudence, accounting, public finance and organization of construction activities.

State University of Iowa, Iowa City—Highways, senior year, 1 hour credit.

University of Kansas, Lawrence—Roads and pavements, 2 credit hours; highway surveys and plans, 1 week at summer surveying camp. Elective: Highway plans and specifications, 2 credit hours; advanced highway engineering, 3 credit hours; highway transport, 2 credit hours.

Kansas State Agricultural College, Manhattan—Highway engineering: (1) principles, senior year, 1st semester, 2 hours class work, 2 semester credits; highway engineering: (2) highway laws, administration, economics, senior year, 2d semester, 2 hours class work, 2 semester credits; highway engineering: (3) laboratory, field and drafting room, 9 hours, 3 semester credits.

University of Kentucky, Lexington—Highway location, construction and maintenance, 2 hours a week, 1st semester; streets and pavements, 5 hours



a week, 1st half of 2d semester; road material, laboratory, 2 hours a week, 2d half of 2d semester; asphalt laboratory, 4 hours a week, 1st half of 2d semester; highway bridge design, drawing, 8 hours a week, 1st half of 2d semester; highway engineering, advanced course for graduate civil engineers, 24 hours a week throughout the year.

Louisiana University and Agricultural and Mechanical College, Baton Rouge—Roads and pavements: road economics and location; earth, gravel, broken stone, miscellaneous roads; street design; pavement foundations; asphalt, brick, cobblestone, stone-block, wood-block pavements; automobile roads, concrete pavements, Fall, 2 hours a week.

Reinforced concrete construction: Concrete and steel in combination; rectangular beams; slabs, cross beams and girders; columns; slab and girder bridges; slab bridges, simple girder bridges; continuous girder bridges; arch bridges; pipe culverts; box culverts; arch culverts. Classroom designs of beams, girders, slabs, bridges and culverts, Fall, Winter, Spring, 3 hours a week.

The Tulane University of Louisiana, New Orleans—Bridge engineering; reinforced concrete; cement testing; railroad mapping and earthwork, surveying and economics, 4 hours a week, 2d term; seniors in civil engineering.

University of Maine, Orono—Highway construction, 2 hours a week, 2 credits; road materials, laboratory, 4 hours a week, 2 credits; highway design, 4 hours a week, 2 credits; highway economics and management, 3 hours a week for one-half semester,  $1\frac{1}{2}$  credits; highway engineering, advanced course, 2 credits. In addition to this all civil engineering students are required to take one credit in strength of materials, laboratory; 2 credits in highway and railroad field work; 2 credits in municipal engineering; 3 credits in earthwork and masonry construction; 8 credits in structures; and  $8\frac{1}{2}$  credits in bridge design, which includes problems in both highway and railroad work.

The Johns Hopkins University, Baltimore, Md.—Highway engineering; an undergraduate course involving the study of highway design, materials, and construction. Three hours weekly, first half-year.

University of Maryland, College Park, Md.—Highways, 4 credit hours each term. Lectures and field work. Required of seniors in civil engineering. Open only to engineering students of senior standing. First term: The principles of location, construction and maintenance of roads and pavements. Second term: Highway contracts and specifications, covering the proposal, bidding and letting of contracts, and a complete analysis of the items that comprise the specifications. A discussion of the cost of highways both to the public and to the contractor and an analysis of the items that influence costs. Third term: The road laws of the various States, highway department organizations. Highway transportation and its interrelationship to other methods of transportation, highway traffic, highway economics and highway financing. Field and drafting room work consists of the necessary surveys, plans and estimates of cost for the construction of a section of improved road.

Massachusetts Institute of Technology, Cambridge—Railway and highway engineering, consisting of a thorough study of curves and earthwork, 60 hours; drafting and design 120 hours; roads and pavements; location, construction and maintenance of roads and pavements for city streets, 40 hours; railway and highway engineering; engineering organization and duties; construction methods and estimates of cost; chemistry of road materials, 75 hours; tests of bitumens, tars, oils, paint, etc., 70 hours; physical tests of various kinds of road materials, 30 hours; highway transportation: types of pavement, trucks, traffic loads, traffic surveys, pavement and grade resistances, economics of motor transport, 80 hours; high-

way design: improvement of an existing road by substitution of improved alignment, grades and new pavement suitable for assumed traffic, 40 hours.

Tufts College, Tufts College, Mass.—Highways, 3 recitations per week for one-half year, required by all junior civil engineering students. Two recitations and one laboratory period per week for 1 year, elective for senior civil engineering students.

Worcester Polytechnic Institute, Worcester, Mass.—Highway construction: land surveying, topographical surveying, railroad curves (theory and practice in location, computation of earthwork, masonry and foundations, reinforced concrete, hydraulics, sewers and drains, bridges (theory and design), laboratory (tests of materials), roads and pavements.

University of Michigan, Ann Arbor—Municipal engineering, 2 hours, 2d semester; highway engineering, 2 hours, both semesters; highway engineering economics and theory, 2 hours, 2 semesters; highway engineering, laboratory, 2 hours, both semesters; highway engineering, design, 3 hours, 2d semester; bituminous paving materials, 1 hour, 1st semester. Graduate Short-Period Courses—Highway transport, 1 hour credit; bituminous surfaces and bituminous pavements, 3 hours' credit; highway laboratory research, 2 to 3 hours' credit; highway bridges, 2 hours' credit; specifications and contracts, 2 hours' credit; earth, gravel and broken stone, 2 hours' credit.

University of Detroit, Detroit, Mich.—Roads and pavements.

Michigan Agricultural College, East Lansing—Agricultural engineering, 5 credits; roads and structures, 3 credits; pavements, 2 credits; road construction, 5 credits; State highway construction, 3 credits; highway law, 2 credits.

University of Minnesota, Minneapolis—Highways and pavements (elementary course); highways and pavements, with laboratory practice (continuation of first course); city planning; highway administration (graduate course).

Mississippi Agricultural and Mechanical College, Agricultural College, Miss.—Highway engineering, Fall semester, 2 hours; rural highways, Spring semester, 1 hour and 2 hours laboratory. Elective: highway design, 3 hours, Spring semester.

University of Mississippi, University—Highway construction; highway engineering, highway surveying.

University of Missouri, Columbia—Road materials; roads and pavements; highway engineering; country roads; highway design.

Washington University, St. Louis, Mo.—Roads and pavements: 3 lectures a week, 2d semester, junior year; roads seminar and laboratory: 3 sessions per week, 1st semester, elective for seniors and graduate students; highway construction and economics: 3 sessions per week, 1st semester, elective for graduate students; highway design and administration: 3 sessions per week, 2d semester, elective for graduate students.

Montana State College—Municipal engineering, autumn, 3 credits, highway engineering, inspection and laboratory tests, spring, 2 credits; highway engineering, preliminary investigations, etc., autumn, 4 credits; highway engineering, roads and pavements, winter, 3 credits.

University of Nebraska, Lincoln—Non-bituminous road materials testing, 3 hours, laboratory, 2 hours' credit, 1st and 2d semesters; bituminous road materials, testing, continued, 6 hours, laboratory, 2 hours' credit, 1st and 2d semesters; research work in rural architecture (farm drainage and rural highways), 2 to 5 hours' credit; irrigation, drainage, and rural highways, 2 hours' attendance, 2 hours' preparation, 5 hours' field work and drawing, 3 hours' credit, 2d semester; railway and highway surveying, 1 hour attendance, 6 hours' field, 2 hours' preparation, 3 hours' credit, 1st semester; roads, streets, and pavements, 2 hours, 4 hours' preparation, 2 hours' credit; highway engineering, laws, administration, financing, con-



struction, and maintenance, 3 hours, 6 hours' preparation, 3 hours' credit, 2d semester; design of highway bridges and culverts, 1 hour, preparation 2 hours, drafting 6 hours, 3 hours' credit, 2d semester; bridge engineering, 1 hour, preparation 2 hours, computation and drafting 6 hours, 3 hours' credit; highway construction, 2 hours, preparation 4 hours, 2 hours' credit; civic design, zoning, street plans, 2 hours, preparation 2 hours, 2 hours' credit.

University of Nevada, Reno—Highway engineering, design, location, construction and maintenance, 4 credits.

Dartmouth College, Thayer School of Civil Engineering—Highway construction and maintenance. Civil engineering course at Dartmouth is 2 years in length, preceded by 3 years of college preparation.

Rutgers College and the State University of New Jersey, New Brunswick—Highway engineering, road and street construction and maintenance, investigation of properties of paving materials and methods of application, senior year, 16 weeks, 2d term, 2 hours a week. Cement testing, laboratory, senior year, 1st term, 16 weeks, 3 hours a week. Testing of materials, laboratory, junior year, 16 weeks, 2d term, 3 hours a week. Testing of concrete, brick and stone as used for paving.

Princeton University, Princeton, N. J.—Highway engineering, 1st term, senior year, 3 credits a week. Municipal engineering, 2d term, senior year, 3 credits a week.

University of New Mexico, Albuquerque—Highway engineering, location, construction, maintenance, cost, durability and methods of financing country roads and city pavements. Two recitation hours per week, 2 credit hours.

New Mexico College of Agriculture and Mechanic Arts, State College—Highway engineering, 3d term, 3 hours.

Polytechnic Institute of Brooklyn, New York—Highway engineering, 2 hours, 2d semester.

Cornell University, Ithaca, N. Y.—Highway and railroad, surveying and mapping, juniors, 5 hours' credit; engineering construction, juniors, 3 hours' credit; highway engineering, seniors and graduates, 3 hours' credit; highway laboratory, juniors, seniors, 3 hours' credit; advanced highway engineering, advanced highway laboratory, highway design, 3 hours each.

The College of the City of New York, New York—Pavements, spring term, 3 hours a week; materials of construction, street pavement and highway materials.

Columbia University, New York City—Highway engineering, maps and road plans.

New York University, University Heights, N. Y.—Highway engineering, 2 hours, 2 credits, 2d term, junior. Optional: highway engineering, 3 hours, 3 credits, 1st term, senior; highway engineering, 2 hours' lecture, 6 hours' design, 5 credits, 2d term, senior.

Union University, Schenectady, N. Y.—Highway engineering, 1½ hours a week, 1st semester, junior year.

Syracuse University, Syracuse, N. Y.—Discussion of various materials and methods of highway construction, city streets and pavements, survey, design and estimate of quantities and cost of a country highway, 2d year, 1-hour lecture, 3 hours' drawing, 2d semester.

Rensselaer Polytechnic Institute, Troy, N. Y.—Surveying, highway engineering, tests of cement, concrete, brick, road metals, chemical analysis of asphalts, design and construction of metal and concrete bridges. Highways, design, construction and economics of roads and pavements.

North Carolina State College of Agriculture and Engineering, State College Station, Raleigh—Highway engineering, masonry construction, 2 periods a week, 1st term; highway engineering, types, methods and materials, 2 periods, 2d term; highway engineering, location and design, 2

periods, 1st term; highway economics, foreign, national and State road systems, types and costs, 2 periods, 2d term; highway surveying, field work, 1 period, 1st term; highway laboratory, 1 period, 2d term; highway bridge design, 3 periods, 2d term.

University of North Carolina, Chapel Hill—Highway engineering, double course, fall and spring quarters.

North Dakota Agricultural College, Agricultural College—Roads and pavements, spring term, 4 credits; roads, spring term, 2 credits; advanced roads and pavements, spring term, 6 credits.

University of North Dakota, University—Municipal engineering, 4 credits, 4 hours a week, first half of semester and last half of second semester, and railway and highway engineering, 4 credits (meeting twice a week through senior year) and earthwork, 1 credit (one afternoon per week, first semester, sophomore year). All above required.

Ohio Northern University, Ada—Course in roads and pavements, etc.

Municipal University of Akron, Akron, Ohio—Highways, study and design of all hard-surfaced roads, as well as dirt roads; street paving; traffic censuses; testing road materials. Cement, theory and manufacture; standard laboratory tests of cement, mortar and concrete; experimental investigations.

University of Cincinnati, Cincinnati, Ohio—Highway engineering, theory; highway engineering, design.

Case School of Applied Science, Cleveland, Ohio—Highway engineering, junior year, 1st term, 3 hours per week; highway engineering, advanced course, senior year, 2d term, 14 weeks, 4 hours per week, lectures, recitations.

Ohio State University, Columbus, Ohio—Roads and pavements, 3 credit hours, 2d semester, 3 recitations a week, 3d year. Auxiliary readings and lectures given.

University of Oklahoma, Norman—Roads and pavements, 4 hours; roads and pavements, advanced course, 4 hours; highway engineering, research and experimentation, 4 hours.

Oklahoma Agricultural and Mechanical College, Stillwater—Roads and pavements, 2 hours class for 1 year; testing road materials, 3 hours laboratory for 12 weeks.

Oregon Agricultural College, Corvallis—Roads and pavements, junior year, 1st term, 5 credits, 5 recitations; highway engineering, senior year, 1st term, 4 credits, 2 recitations, 2 laboratory periods; highway engineering, continued, 2d term, 3 credits, 2 recitations, 1 laboratory period; highway engineering, continued, 3d term, 4 credits, 2 recitations, 2 laboratory periods; highway transportation, senior year, 3 credits, 3 recitations; municipal engineering and city planning, senior year, 3d term, 3 recitations; economics of highway construction, senior year, 1st term, 3 credits, 3 recitations. Contracts and specifications, 3 credits, 3 recitations; cement and highway laboratory, 3 credits, 3 laboratory periods per week. (Above also in undergraduate course.) Graduate course in highway engineering—road design, 2 periods a week, construction of roads, 3 periods a week, highway bridges, 3 periods a week; cement and highway laboratory, 3 laboratory periods a week; street design and construction, 3 periods a week; reinforced concrete highway structures, 3 periods a week; contracts and specifications, 2 periods a week; hydraulics of highway drainage and construction, 1 laboratory period a week.

Allegheny College, Meadville, Pa.—Highway surveying, 2d term, 3 hours; road construction and maintenance.

Lafayette College, Easton, Pa.—Roads and pavements, a study of the principles and practices underlying the design, construction and maintenance of highways. Second term, sophomore year, 2 recitations per



week, 2 credit hours. Periods in laboratory work given in connection with this course are included in the time scheduled for general testing.

Bucknell University, Lewisburg, Pa.—Roads and pavements, 1st semester, 1 hour; 2d semester, 2 hours.

University of Pennsylvania, Philadelphia—Roads and pavements, 1st term, 2 hours; highway, bridge design, 2d term, 3 hours; advanced highway, bridge design, 2d term, 3 hours.

Carnegie Institute of Technology, Pittsburgh, Pa.—Highway engineering; materials.

University of Pittsburgh, Pittsburgh, Pa.—Roads and pavements, junior year, spring term, 2 lectures and 3 hours design per week; highway materials (testing laboratory), 1 lecture and 3 hours laboratory per week; roads and pavements, senior year, 2d semester, 1 recitation and 3 hours laboratory per week. Sophomore year—Highway inspection methods, 1 lecture and 3 hours laboratory. Highway location, 1 lecture and 6 hours design. Junior year—Bituminous materials, laboratory 3 hours. Senior year—Highway engineering, 3 lectures of recitations per week, 2 terms. Highway transportation, 3 lectures per week.

Lehigh University, South Bethlehem, Pa.—Highway engineering.

Pennsylvania State College, State College—Highway engineering, junior year, 2d semester, recitations 2 hours, 2 credits; highway materials, laboratory, senior year, 1st semester, practicum 3 hours, 1 credit; tests of road materials, senior year, 2d semester, practicum 3 hours, 1 credit; highway engineering, senior year, 1st semester, practicum 3 hours, 1 credit; highway engineering, senior year, 2d semester, practicum 3 hours, 1 credit; highway engineering and land drainage, junior year, 1st semester, practicum 5 hours, credit 5 hours.

Swarthmore College, Swarthmore, Pa.—Highway engineering, 2 hours, 1st semester, lectures; investigations and reports on local construction. A critical study of present types of pavements and their economy under various conditions.

Villanova College, Villanova, Pa.—Highway engineering.

Rhode Island State College, Kingston—Roads and pavements, 3 recitations, credit and 1 field credit, 2d term.

Brown University, Providence, R. I.—Highway engineering, 3 hours, 1st and 2d semesters.

Clemson Agricultural College, Clemson, S. C.—Roads and pavements; seniors: 3 credit hours, 2d term. Masonry design (bridges, culverts) seniors, 3 credit hours, 1st term. Drainage (part of course in sewerage) 3 credit hours, 3d term. Contracts and specifications, 2 credit hours, 3d term.

University of South Carolina, Columbia—Highway construction, special two-year course; civil engineering (2), roads and pavements, lectures and recitations, 1st term.

University of South Dakota, Vermillion—Roads and highways, 1st semester, 3 hours, 3 credit hours.

South Dakota State College, Brookings—Roads and pavements, 1st term, 3 credits; highway engineering, 2d term, 2 credits; highway engineering, 3d term, 2 credits; reinforced concrete bridge design, 2d term, 3 credits.

South Dakota State School of Mines, Rapid City—Four-year course in civil engineering. Highway construction; bridge design, 6 hours drafting per week, seniors; concrete construction, 3 lectures per week, seniors; masonry construction, 2 lectures per week and 3 hours drafting, seniors; roads and pavements, 3 lectures and 3 hours laboratory, seniors. Structural details, 3 hours drafting per week, seniors; tests upon cement and aggregates are made in our laboratory course in strength of materials, juniors.

University of Tennessee, Knoxville—Highway engineering, 1st term, 3 recitations and 2 problem periods; highway bridge design, 2d term, 2 design periods; for students specializing in highway engineering, organization of highway departments, etc., 2d term, 3 hours; design of highway bridges, 2d term, 3 design periods. Six weeks' short course for highway engineers—elementary mathematics; drawing and computations; materials testing, non-bituminous and bituminous; elements of mechanics; highway field engineering; highway design and construction; highway economics and organization.

Vanderbilt University, Nashville, Tenn.—Highway construction in municipal engineering; highway steel bridges in steel structures; highway concrete bridges in masonry structures.

University of Texas, Austin—Highway engineering, location, construction and maintenance; highway engineering, including specifications and contracts; highway laboratory; highway bridges, especially for country purposes; advanced highway engineering.

Agricultural and Mechanical College of Texas, College Station—Roads and pavements; highway construction and maintenance; highway surveys and plans; highway laboratory, highway materials and bituminous mixtures; bridge design, steel highway bridges; highway bridges and culverts; highway laws and economics.

Rice Institute, Houston, Texas—Municipal engineering.

University of Utah, Salt Lake City—Highway construction, road materials, laboratory.

Agricultural College of Utah, Logan—Road construction, fall quarter, 5 hours, 5 credits; road maintenance, winter quarter, 5 hours, 5 credits; roads, materials, winter quarter, 3 hours, 3 credits; canal and road surveying, instruction and practice in the application of the surveying methods used in the laying out and construction of canals and roads, fall quarter, 5 credits.

University of Vermont and State Agricultural College, Burlington—Highway engineering, 4 hours, 2d semester.

Virginia Polytechnic Institute, Blacksburg—Civil engineering, juniors; highway engineering, 3 hours per week; senior year, for students specializing in highway engineering: highway engineering, 1 hour per week, 1st term, 2 hours per week 2d term, 1 hour per week 3d term; highway location, 9 hours per week 1st term; highway testing, laboratory, 9 hours per week 2d term.

University of Virginia, Charlottesville—Roads, streets, street railways, spring term; road materials testing, spring term.

Virginia Military Institute, Lexington—Highway engineering, roads and pavements, 3 hours a week, 2d term; design of highway and railroad bridges, 3 hours a week, 2d term.

Washington and Lee University, Lexington, Va.—Highway engineering. The course in highway engineering extends over a period of 5 months, 4 times a week and includes field work, office work and recitations on the location, design and construction of highways, with special attention to the interrelation of our national, State and county highways.

State College of Washington, Pullman—County roads, 2 hours, 1st semester; highway engineering, 3 hours, 2d semester; advanced highway engineering, one recitation and 3 hours laboratory per week, 1st semester; design of concrete and highway bridge, 2 hours preparation and 4 hours drafting per week. Design of steel bridges 4 hours preparation and 6 hours drafting per week.

University of Washington, Seattle—Field engineering, 4 credits, spring. Highways, location and construction of standard types, 3 credits, spring. Roads and pavements, materials, construction and maintenance. Laboratory study of materials of construction, 5 credits, autumn. Materials of Con-



struction, 5 credits, autumn. Road materials, bitumens and methods of testing, an elective for students in civil and chemical engineering, 2 credits, spring.

West Virginia University, Morgantown—Roads and pavements, 3 hours, 1st semester; highway engineering, 3 hours, 2d semester; highway laboratory (credit varies); land surveying, 3 hours, railroad location, 3 hours; advanced surveying, 2 hours, railroad maintenance, 3 hours; topographic surveying, 2 hours.

University of Wisconsin, Madison—City planning, 1st semester, 2 credits; city planning, 2d semester, 2 credits; country roads, 2d semester, 1 credit; introduction to construction and maintenance, 3 credits; advanced economics, designs, estimates, inspection trips, 2d semester, 3 credits; analysis of highway bitumens, 2d semester, 2 credits (included in the following course); testing road materials, 2d semester, 3 credits; highway bridges and culverts, 2d semester, 2 credits.

University of Wyoming, Laramie—Road and railroad surveying, spring, 3 credit hours; roads, fall, 3 credit hours; excavation, spring, 3 credit hours; testing materials, winter, 3 credit hours.

### Courses in Highway Transport

The following list of institutions comprise the larger proportion of those which are devoting attention to highway transport, highway economics and related subjects:

St. Viators College, Bourbonnais, Illinois,

Highway Transport.

New York University, New York City,

Automotive Transportation.

Syracuse University, Syracuse, N. Y.,

Course in Transportation including Highway Transportation.

Massachusetts Institute of Technology, Cambridge, Mass.,

Highway Transport.

University of Chicago, Chicago, Ill.,

Traffic and Transportation.

University of Arkansas,

Highway Transport.

Duquesne University, Pittsburgh, Pa.,

Traffic and Transportation.

Temple University, Philadelphia, Pa.,

Traffic and Transportation.

New Hampshire College, Durham, N. H.,

Highway Transportation in Department of Economics.

Massachusetts Agricultural College, Amherst, Mass.,

Transportation of Agricultural Products.

University of Pennsylvania, Philadelphia, Pa.,

Course in Highway Transport.

Salem College, Salem, West Va.,

Requires a Thesis on Highway Transport in Course on Transportation.

Virginia Polytechnic Institute, Blacksburg, Va.,  
Course in Transportation Given with the Prominence  
Shown to Highway Transport.

Union College, Schenectady, N. Y.,  
Includes Highway Transport in the Course in Transportation.

University of Alabama, University, Ala.,  
Highway Transport.

Worcester Polytechnic Institute, Worcester, Mass.,  
Time for Study of Highway Engineering has been  
Doubled. Gives Four Periods to Study of Transport.

University of Pittsburgh, Pittsburgh, Pa.,  
Special Course in Highway Transport.

University of Michigan,

Graduate Short Period Courses:

American and English Highway Transport Methods.  
Highway Transport Legislation and Traffic Regulations.

Interrelationship of Highway, Railway and Waterway Transport.

Highway Transport Costs and Record Systems.

Highway Transport Management.

Highway Transport Economics and Surveys.

Highway Transport Seminar.

Boston University, Boston, Mass.,

Thirty Class Hours in Economics of Auto-Transportation as a Part of a Four-Hours a Week Course in Railroad Transportation.



## ACCIDENT PREVENTION SUGGESTIONS

By M. O. ELDRIDGE

**F**ATALITIES among motorists and pedestrians are occurring annually in appalling numbers on the public highways and streets of this country. Approximately 80,000 persons were killed accidentally in the United States in 1919, of which about 10,000 were killed as a result of automobile accidents of one kind or another. Unfortunately, about 28 per cent of all the persons killed by automobiles were children under fifteen years of age.

Obviously, the trouble is due to increased motor vehicle traffic. A city of 100,000 population today has more vehicles on its streets than a city of a million population ten years ago.

The blame for this startling mortality on our highways is charged by some to the speed maniac who cares not for the life or limb of the pedestrian, so long as his own skin is unscathed. Others place the blame on the careless pedestrian who thinks that he has a right to use the public streets and highways wherever and whenever he pleases. Still others place the blame on unsafe highway conditions, to dangerous railroad grade crossings, etc., etc.

As a matter of fact, accidents on highways are due to all of these and many other causes, and it is, therefore, desirable that accident statistics be gathered in considerable quantity and detail and that the causes be analyzed with a view to determining where the trouble exists and the remedies which should be applied.

Some facts and figures have already been collected and used in educational and safety-week campaigns by which accidents on highways and streets have been greatly reduced. For several years the State of Iowa has collected and published statistics of this sort. Recently the State highway authorities of Maryland made a survey of accidents occurring on State highways in which fourteen fatalities between May and July, 1921, were classified as follows:

Failure to heed warning at railway crossing.....	2
Speeding .....	4
Driving on wrong side of road.....	4
Reckless driving .....	4

The Maryland authorities report that careful motorists usually drive with caution in presence of recognized dangers, such as steep grades, sharp curves, grade crossings, etc., while the absence of such dangerous features gives the driver a sense of security which prompts him to take a chance and yield to the well-nigh universal passion for speed.

According to the United States census, deaths resulting from automobile accidents in sixty-six cities in the United States have increased from 1,955 in 1915 to 3,808 in 1919, an increase of 95 per cent. During the same period, automobile registrations increased from 2,453,780 to 7,523,664, or about 215 per cent, which indicates that the death rate from motor-vehicle accidents is not increasing in the same ratio as the number of vehicles.

The Interstate Commerce Commission has for a number of years been collecting valuable information and statistics relating to grade-crossing accidents throughout the country, which is one of the greatest single causes of accidents and deaths on the highways. A digest of the killed and injured at grade crossings from 1917 to 1920 is as follows:

<i>Year</i>	<i>Killed</i>	<i>Injured</i>	<i>Total</i>
1917.....	1,969	4,764	6,733
1918.....	1,853	5,683	6,535
1919.....	1,784	4,616	6,400
1920.....	1,791	5,077	6,868



Death Lurks at the Grade Crossing—Beware

Thus it appears that there have been killed at grade crossings during the four years 1917 to 1920 a total of 7,396 persons, the killed and injured numbering 26,536. A crumb of comfort may be gained from the fact that fewer persons were killed at grade crossings in 1920 than in 1917 or 1918, in spite of the tremendous increase in motor-vehicle traffic. This is probably due to safety-first campaigns carried on by the railroads, automobile clubs, and other organizations, and to the elimination of many dangerous



grade crossings; to the protection of other grade crossings by gates, watchmen, bells, wig-wag signals and other similar devices, and to the placing of crossing signs at sufficient distance from crossings to give ample warning to motorists.

### **Problem of Grade Crossings**

It would seem utterly impossible to eliminate all the grade crossings in the United States, for the simple reason that the cost of such work would in all probability amount to more than the total cost of the railroads. The remedy would, therefore, seem to lie in the elimination of a few of the more dangerous crossings each year and to the placing of watchmen, gates, and other suitable signals at the less dangerous crossings.

The United States Bureau of Public Roads has recently announced that no grade crossing will be allowed to remain on the primary roads of the new Federal highway system that it is at all practicable to avoid. Every effort will be made to make the roads of the secondary system equally safe, but in this case it is recognized that the elimination may not always be practicable because of the cost. The policy of the bureau is meeting with hearty co-operation on the part of the States, and the American Association of State highway officials by resolution has pledged its best efforts to eliminate grade crossings on new construction.

Some underpasses already constructed, even on important trunk-line highways, are almost as dangerous as grade crossings, because they are frequently placed on sharp curves and at right angles to the line of traffic; thus causing head-on or rear-end collisions of motor vehicles. In future work of this kind, the interests of the traveling public would be best served by so installing these structures as to obtain a clear view of the road ahead to a distance of at least 300 feet.

Accidents on highways may be attributed to a number of causes, among which should be mentioned the mania for speed; inefficiency and carelessness of motor vehicle drivers; defective mechanism; glaring or insufficient headlights and the lack of lights on horse-drawn vehicles; jay-walking; non-uniformity of traffic rules and regulations in different jurisdictions; pedestrians using the right-hand side of the road instead of the left in the open country; non-observance of rights-of-way rules; vehicles passing other vehicles on the wrong side, and vehicles passing street cars while discharging or taking on passengers.

The great majority of motor-vehicle accidents are probably caused by the speed crank who is always trying to get ahead of a train or street car or another vehicle. It would seem better to arrive at one's destination a minute or two late rather than to arrive in eternity ahead of time.

Many highway accidents are caused by persons who fail to observe the common courtesies or rules of the road which are so well known as to be almost universal in their application. If every motorist would extend the same courtesies "to the other fellow" that he expects the other fellow to extend to him, the highways would be safer for everybody.

Improper lighting of motor vehicles is responsible for numerous accidents, especially on country roads. The blame for such accidents is generally placed on glaring headlights. As a matter of fact, many of these accidents are due to insufficient light to enable the motorist to see where he is going. A headlight which is pro-



The under-pass or the over-pass is the saver

ducing enough light on the road—which it will do if properly equipped—will not bother the other fellow provided he is similarly equipped. The chief cause of glare appears to be faulty adjustment of bulbs in the headlights. What the motorist wants is light and more light, but he wants it thrown down on the road where it will do him some good and do the other fellow no harm.

No motor vehicle should be allowed to operate unless it has *sufficient* light, so adjusted as to enable the driver to distinguish clearly vehicles, persons or objects at least two hundred feet ahead. Equipped with the approved lenses and bulbs properly focused in accordance with the rules laid down by the Illuminating Engineering Society, the horizontal rays thus produced are so con-



centrated on the road surface as to eliminate glare, which is so dangerous to both motorist and pedestrian.

Among the highway hazards which cause numerous accidents may be mentioned sharp curves where the line of sight is impaired by embankments, buildings, or other obstructions, excessive grades, narrow bridges, slippery road surfaces, dangerous and improperly marked detours, and defective road surfaces and bridges and roads which are too narrow to accommodate the traffic. Widening and super-elevation on sharp curves makes for safety.

Most of these defects were not thought to be serious at the time the roads were built. The great changes that have taken place within a few years in the volume of highway traffic, the greatly increased number of motor vehicles, and the greater speed at which they travel have made roads dangerous that formerly were fairly safe. It is not possible to correct all such dangerous places at once on account of the cost, but the State highway departments are eliminating the worst places as rapidly as possible. To discover these worst places the State of Maryland has developed a system of accident reporting. All accidents on the State highways are reported, their location is marked by pins in a map and a full description of the nature of the accident is recorded, together with the evidence as to the probable cause. The concentration of pins at various points on the map very quickly reveals the places that need attention, and the State is acting upon the evidence furnished by the map.

Chief among the causes of accidents in the cities appears to be the lack of uniform traffic rules and regulations which definitely prescribe those sections of streets which may be used by vehicles and pedestrians respectively. Some cities have already enacted ordinances prohibiting jay-walking and which require pedestrians to cross the streets at crossings in congested districts.

Many well-intentioned but misinformed persons are inclined to place the blame for the majority of motor-vehicle accidents on the motorist. That this is not the case, however, is shown by a traffic study conducted in 1919 by the Department of Health of New York City.

The records of the New York Police Department relating to accidents caused by automobiles were tabulated into three classes: (1) Those caused by carelessness of operators; (2) those due to defective mechanism; (3) those due to carelessness on the part of the person injured, the pedestrian. In the first two classes 800 accidents were due to carelessness on the part of the operator and 700 the result of defective mechanism, a total of 1,500 chargeable to vehicular operation.

Against this figure, it was found that 9,000 accidents were due to carelessness on the part of the person injured, or six times

the number caused by carelessness of automobile drivers. Of this 9,000, one-third were injured while crossing streets elsewhere than at crossings, thus sustaining the A.A.A. contention that until pedestrian traffic is regulated there will be slight decrease in the number of street accidents in which motor vehicles and pedestrians are concerned.

The time is probably not far distant when motor vehicles using the public streets will be required to slow down at each *properly designated* crossing in order to be able to bring the vehicle to a dead stop under any circumstances before crossing the street, with the other requirement that no pedestrian shall attempt to cross the street at any other than these points. When these rules are adopted and enforced, there will doubtless be a tremendous reduction in the number of accidents and fatalities from the use of automobiles.

Much effective work may be done along this line by students in colleges by collecting and digesting motor-vehicle accident statistics and by pointing out the remedies. Campaigns of education, safety-first weeks, and instruction to school children on safety problems will also accomplish much good.

As an illustration, the public schools in the city of Detroit—for as a result of efforts made by the Detroit Automobile Club—for the past three years have been teaching safety problems in the public schools in connection with health education. During the first year in which such work was carried on, accidents to school children decreased 5.5 per cent. During 1920, accidents to school children decreased 29.7 per cent under 1918.

With the ever-increasing number of passenger cars and commercial vehicles, the problem of handling traffic on the highways is becoming as important as the traffic problems of the great trunk-line railways, and sooner or later the highway departments of the different States will doubtless find it desirable to establish traffic bureaus, presided over by traffic engineers who will, in co-operation with the construction, maintenance and bridge engineers, handle all problems relating to traffic.

Lack of uniformity in the traffic laws and regulations of the various States and cities is doubtless responsible for many accidents, for the motor vehicle has blotted out State lines.

Last November President Harding signed the Federal Highway Act, the purpose of which is to give us eventually a connected system of National roads. Both the spirit and the terms of the Act show that it was the intention of Congress that the system built should be consistently built to render uniform service to traffic throughout its whole extent. The minimum width of road surface is carefully specified, the character of the roads built is to be finally determined by one agency, the Federal Bureau, which will make for a uniform policy. But the purpose of the



national law makers will be very largely nullified if different regulations for the use of these National roads are set up in each State through which they pass.

To overcome this difficulty, a committee representing the American Association of State Highway Officials, the Motor and Accessory Manufacturers' Association, National Automobile Chamber of Commerce, National Automobile Dealers' Association, the Rubber Association of America, the Trailer Manufacturers' Association of America, and the American Automobile Association prepared some time ago a proposed uniform vehicle law.

While this law may not represent the last word in motor-vehicle regulation, still it contains the best thought of the best informed men in the country on this subject. The fundamental principles laid down in this law have already been incorporated in the laws of some of the States and it is believed that if these principles were generally adopted throughout the country it would go a long way toward solving our traffic problems and of preventing many accidents.

## AUTOMOBILE REGISTRATIONS 1921 <sup>1</sup>

**F**INAL revised figures show that there were 10,505,660 cars and trucks registered in the United States during 1921. This is an actual gain of 1,573,202 over 1920; a percentage gain of 17.6 per cent. There is now one car for every 10.2 persons in the country; \$122,038,613 in fees were collected from car owners.

It should be noted at once that a little over 200,000 of this gain in registration is merely an apparent statistical gain, due to the fact that proper figures for the State of Minnesota and for the District of Columbia are now available for the first time. Even though this is the case, however, the gain for 1921 equals that of 1920, a distinctly encouraging result in view of the depressed condition of business during the last year.

Since motor vehicles have come to be used to largely for utility purposes, it is interesting to discuss the registration figures in relation to the various industrial activities of the several States. For this purpose an arbitrary division may be made as follows, a State being classified according to the type of industrial activity which predominates within its borders:

1—*Manufacturing States:*

Massachusetts, New York, Pennsylvania, Michigan, Indiana, Delaware, Connecticut, Rhode Island, New Jersey and Wisconsin.

2—*Agricultural States:*

Arkansas, North Dakota, South Dakota, Kansas, Minnesota, Nebraska, Oregon, Oklahoma, Texas, Washington and Iowa.

3—*Mining States:*

Wyoming, Nevada, Utah, Montana, Colorado, Arizona, Idaho and New Mexico.

4—*Southern States:*

Florida, Georgia, Virginia, North Carolina, South Carolina, Kentucky, Tennessee, Louisiana, Mississippi, Alabama, West Virginia.

The population and registration of these four groups line up in this way:

<i>Group</i>	<i>Population</i>	<i>Registration</i>
Manufacturing .....	38,350,503	3,568,462
Agricultural .....	20,100,362	2,591,205
Mining .....	3,445,116	400,531
Southern .....	22,902,405	1,175,281

It may be noted here that the population figures used in making the calculations throughout this article are those estimated by the Federal Bureau of Census for July 1, 1921. Using these as a

<sup>1</sup> Reprinted from *Automotive Industries*, March 16, 1921, p. 310 and 320 to 324.



basis, it appears that the agricultural States have the most dense automobile population, followed by the mining, manufacturing and southern groups in the order named. This order is the same as last year, but a comparison of the persons per car in these groups in 1920 and 1921 shows one or two interesting features. The figures for these two years are as follows:

<i>Group</i>	<i>Persons Per Motor Vehicle</i>	
	1920	1921
Agricultural States .....	8.10	7.76
Mining States .....	8.90	8.61
Manufacturing States .....	12.00	10.72
Southern States .....	20.08	19.50

This comparison indicates that the potential development possibilities of the group of southern States has not been realized to any great extent during the past year. This is true despite the fact that a large percentage of the population in these States is colored and that a large percentage of the colored population does not comprise a market.

NET REGISTRATION OF PASSENGER CARS, TRUCKS AND MOTORCYCLES AND GROSS RECEIPTS THEREFROM FOR THE 1921 REGISTRATION YEAR.

State	Total Net Registration	Passenger Cars	Commercial Cars	Motorcycles	Total Fees
Alabama.....	82,343	73,233	9,110	805	\$1,147,265
Arizona.....	35,049	31,069	3,980	440	195,970
Arkansas.....	67,446	66,480	966	192	678,984
California.....	673,830	638,922	34,908	17,603	6,790,981
Colorado.....	145,739	136,336	9,403	2,868	906,059
Connecticut.....	137,526	110,316	27,210	5,589	2,033,838
Delaware.....	21,413	.....	.....	541	375,469
District of Columbia.....	71,645	54,147	6,976	2,487	383,289
Florida.....	97,837	82,992	14,845	1,296	750,000
Georgia.....	131,942	46,935	4,359	1,338	1,703,913
Idaho.....	51,294	590,527	79,907	744	843,951
Illinois.....	670,434	357,025	43,317	7,104	6,803,456
Indiana.....	400,342	430,003	30,525	7,524	2,422,171
Iowa.....	460,528	269,661	21,648	3,897	7,718,926
Kansas.....	291,309	111,227	15,144	2,271	3,000,000
Kentucky.....	126,371	70,000	10,500	1,185	1,771,887
Louisiana.....	80,500	67,591	9,936	498	453,276
Maine.....	77,527	128,042	12,530	1,525	1,004,914
Maryland.....	140,572	305,471	55,261	7,847	2,460,162
Massachusetts.....	360,732	426,984	50,053	12,048	4,717,389
Michigan.....	477,037	301,900	26,800	6,195	6,751,925
Minnesota.....	328,700	58,429	6,710	3,500	5,616,114
Mississippi.....	65,139	.....	.....	375	537,462
Missouri.....	346,437	.....	.....	3,609	2,505,354
Montana.....	58,785	219,781	18,923	472	594,521
Nebraska.....	238,704	.....	.....	1,866	2,819,629
Nevada.....	10,819	.....	.....	130	102,800
New Hampshire.....	42,039	36,994	5,045	2,358	876,322
New Jersey.....	272,994	248,477	24,517	9,724	4,106,269
New Mexico.....	24,703	.....	.....	214	255,000
New York.....	812,031	630,791	181,240	26,998	10,000,000
North Carolina.....	148,684	134,884	13,800	1,276	2,250,000
North Dakota.....	92,644	90,221	2,423	810	683,052
Ohio.....	720,632	622,044	98,588	23,026	6,886,205
Oklahoma.....	221,300	.....	.....	1,013	2,592,195
Oregon.....	118,325	103,735	14,590	3,164	2,334,782
Pennsylvania.....	689,589	632,541	57,048	21,111	9,460,895
Rhode Island.....	54,957	45,059	9,898	1,780	847,083
South Carolina.....	90,546	83,349	7,197	756	733,820
South Dakota.....	119,274	110,997	8,277	682	720,587

NET REGISTRATION OF PASSENGER CARS, TRUCKS AND MOTORCYCLES AND GROSS RECEIPTS  
THEREFROM FOR THE 1921 REGISTRATION YEAR—Continued.

State	Total Net Registration	Passenger Cars	Commercial Cars	Motorcycles	Total Fees
Tennessee.....	117,025	102,795	14,230	1,043	1,387,374
Texas.....	467,616	.....	.....	3,905	2,146,873
Utah.....	47,523	40,587	6,936	909	441,359
Vermont.....	36,965	33,478	3,487	965	668,289
Virginia.....	141,000	125,000	16,000	2,200	2,100,000
Washington.....	185,359	156,693	28,666	3,763	2,925,731
West Virginia.....	93,894	89,397	4,497	1,539	1,600,000
Wisconsin.....	341,841	320,577	21,264	6,423	3,644,950
Wyoming.....	26,619	.....	.....	322	288,122
Totals.....	10,505,660	8,184,690	1,010,714	207,930	\$122,038,613

Persons Per Motor Vehicle, December 31, 1921.	Cars and Trucks in the United States, December 31, 1921.	Percentage Gain in Registration, December 31, 1920 to December 31, 1921.
Iowa..... 5.28	New York..... 812,031	Florida..... 32.40
South Dakota..... 5.38	Ohio..... 720,632	Maine..... 23.28
Nebraska..... 5.49	Pennsylvania..... 689,589	Louisiana..... 22.00
California..... 5.78	California..... 673,830	New York..... 21.35
Kansas..... 6.14	Illinois..... 670,434	New Hampshire..... 21.23
Colorado..... 6.61	Michigan..... 477,037	Pennsylvania..... 20.91
Oregon..... 6.76	Texas..... 467,616	Maryland..... 20.81
Nevada..... 7.07	Iowa..... 460,528	Indiana..... 20.22
North Dakota..... 7.09	Indiana..... 400,342	New Jersey..... 19.92
Dist. of Columbia..... 7.35	Massachusetts..... 360,732	West Virginia..... 19.16
Indiana..... 7.41	Missouri..... 346,437	Massachusetts..... 18.47
Minnesota..... 7.41	Wisconsin..... 341,841	California..... 18.41
Washington..... 7.47	Minnesota..... 328,700	Illinois..... 17.91
Wyoming..... 7.55	Kansas..... 291,309	Delaware..... 17.11
Wisconsin..... 7.84	New Jersey..... 272,994	Ohio..... 17.10
Michigan..... 7.97	Nebraska..... 238,704	Vermont..... 16.84
Ohio..... 8.20	Oklahoma..... 221,300	Missouri..... 16.71
Idaho..... 8.75	Washington..... 185,359	Wisconsin..... 16.61
Oklahoma..... 9.09	North Carolina..... 148,684	Michigan..... 15.59
Utah..... 9.69	Colorado..... 145,739	Connecticut..... 15.41
Vermont..... 9.77	Virginia..... 141,000	Tennessee..... 14.91
Montana..... 9.83	Maryland..... 140,572	Arkansas..... 14.18
Illinois..... 9.87	Connecticut..... 137,526	Oregon..... 14.04
Missouri..... 9.92	Georgia..... 131,942	Colorado..... 13.02
Maine..... 9.95	Kentucky..... 126,371	Kentucky..... 12.12
Arizona..... 10.10	South Dakota..... 119,274	New Mexico..... 11.71
Maryland..... 10.21	Oregon..... 118,325	Utah..... 11.58
Texas..... 10.21	Tennessee..... 117,025	Wyoming..... 11.23
Florida..... 10.22	Florida..... 97,837	Alabama..... 10.31
Connecticut..... 10.35	West Virginia..... 93,894	Kansas..... 9.78
Delaware..... 10.53	North Dakota..... 92,644	Texas..... 9.35
New Hampshire..... 10.59	South Carolina..... 90,546	Rhode Island..... 9.10
Massachusetts..... 10.89	Alabama..... 82,343	Oklahoma..... 8.30
Rhode Island..... 11.21	Louisiana..... 80,500	Nebraska..... 7.05
New Jersey..... 11.94	Maine..... 77,527	Washington..... 6.60
Pennsylvania..... 12.90	Arkansas..... 67,446	North Carolina..... 5.58
New York..... 12.99	Mississippi..... 65,139	Iowa..... 5.33
New Mexico..... 14.78	District of Columbia..... 61,745	Virginia..... 5.23
West Virginia..... 16.04	Montana..... 58,785	Nevada..... 3.39
Virginia..... 16.68	Rhode Island..... 54,957	Mississippi..... 2.62
North Carolina..... 17.55	Idaho..... 51,294	North Dakota..... 1.98
South Carolina..... 18.85	Utah..... 47,523	Arizona..... 1.42
Kentucky..... 19.23	New Hampshire..... 42,039	Idaho..... .83
Tennessee..... 20.09	Vermont..... 36,965	Losses
Georgia..... 22.35	Arizona..... 35,049	Georgia..... 8.65
Louisiana..... 22.61	Wyoming..... 26,619	Montana..... 3.07
Arkansas..... 26.39	New Mexico..... 24,703	South Carolina..... 2.44
Mississippi..... 27.40	Delaware..... 21,413	South Dakota..... .93
Alabama..... 29.50	Nevada..... 10,819	
	Total..... 10,505,660	



It is interesting to note that as regards persons per car the manufacturing States, which in 1920 already had but half as many persons per car as the southern States, reduced their number of persons per car by 1.28 during the past year, while the southern States reduced only .58.

The figures for the great grain-growing States, as well, indicate a healthy condition as regards cars and trucks, despite the fact that the value of the grain crop in 1921 decreased 48 per cent, while the volume decreased only  $1\frac{1}{2}$  per cent, compared with the five-year average (1914-1918) production and value.

In the midst of this unfavorable condition registrations increased 75,296 during 1921 in the group of grain States comprising South Dakota, North Dakota, Minnesota and Kansas. In making this calculation the number of cars in Minnesota for 1920 has been estimated at 280,000, since exact figures will never be available. This means that the number of persons per car in this group of States has been reduced during the period of business depression, using the 1920 and 1921 population figures respectively in making the calculation. For these four States the numbers of persons per car were as follows:

1920.....	7.23 persons per vehicle
1921.....	6.64 persons per vehicle

These figures show a favorable condition from an automotive standpoint when taken in conjunction with the fact that Iowa, the great corn State, showed an increased registration of 23,228. The Iowa figures shown in the preliminary report gave that State a loss in registration for the year, but the final figures indicate the material gain recorded above. This constitutes the only major change from the preliminary compilation, although New York and one or two other States have materially increased totals.

### New York Still on Top

New York still leads in total registrations. There is no change, in fact, in the first five States. Iowa, however, has dropped behind Michigan and Texas and now stands eighth instead of sixth.

New York also leads in actual registration gain for the year, while Pennsylvania is also ahead of Ohio, the State which had the largest numerical gain last year. Five States gained more than 100,000 in registrations during 1921. These States were as follows:

New York .....	142,741
Pennsylvania .....	119,425
Ohio .....	105,235
California .....	104,938
Illinois .....	101,675

The final figures show registration losses in four States, Georgia having lost 12,480; South Carolina, 2,272; Montana, 1,861, and South Dakota, 1,121. This is the first time that losses have been recorded in any State, but the character of the losses is such as to eliminate a possibility of the assumption that they are due to "saturation" of the States involved.

South Carolina has 18 persons per motor vehicle, Georgia has 22, and Montana about 10. South Dakota has 5.38, but its drop is obviously to be attributed to the peculiarly unfavorable economic position in which that State has been during the last year.

### Florida Has Large Percentage Gain

The largest percentage gain in registration was made by Florida, which has 32.40 per cent more motor vehicles than last year. Louisiana is the only other southern State that has gained more than 20 per cent. Although it has always led in total registrations, New York is still to be found near the top of percentage gain. It stands in fourth place this year, with a gain of 21.35 per cent, despite its already large gross total.

#### GAIN MADE IN CAR AND TRUCK REGISTRATION, 1920-1921.

New York.....	142,741	New Hampshire.....	7,359
Pennsylvania.....	119,425	Virginia.....	7,000
Ohio.....	105,235	Vermont.....	5,340
California.....	104,938	Utah.....	4,945
Illinois.....	101,675	Rhode Island.....	4,582
Indiana.....	67,635	Delaware.....	3,113
Michigan.....	64,320	Wyoming.....	2,693
Massachusetts.....	56,101	New Mexico.....	2,594
Missouri.....	49,518	North Dakota.....	1,804
Wisconsin.....	48,543	Mississippi.....	1,655
New Jersey.....	45,257	Arizona.....	490
Texas.....	39,923	Idaho.....	421
Kansas.....	25,913	Nevada.....	355
Maryland.....	24,231	District of Columbia.....	52,033
Florida.....	23,923	Minnesota.....	263,183
Iowa.....	23,228		
Connecticut.....	18,392		1,590,936
Oklahoma.....	17,000		
Colorado.....	16,788		
Nebraska.....	15,704		
Tennessee.....	15,173		
West Virginia.....	15,032		
Maine.....	14,620		
Oregon.....	14,535		
Louisiana.....	14,500		
Kentucky.....	13,686		
Washington.....	11,439		
Arkansas.....	8,364		
North Carolina.....	7,824		
Alabama.....	7,706		

#### DECREASES IN CAR AND TRUCK REGISTRATION

Georgia.....	12,480
South Carolina.....	2,272
Montana.....	1,861
South Dakota.....	1,121
	17,734
Net Gain.....	1,573,202

Idaho has the smallest gain, its increase over 1920 being only .83 per cent. Minnesota and the District of Columbia are not included in the list of percentage gains, because their gains, as noted before, are chiefly statistical rather than actual.

To use the accompanying tables intelligently, it is necessary to take into account certain variables which are involved in the registration methods of the various States.



To begin with, there is little possibility of determining accurately, under present conditions, the division between car and truck registrations. In *Automotive Industries* of November 17 a detailed explanation was given as regards the possibility of getting this segregation accurately. The result of this analysis showed that by extensive research it is possible to get passenger-car figures which will be accurate for all practical purposes, involving an error of only about 1 per cent, but that no such accuracy is possible in regard to truck figures, as the error may run anywhere from 25 per cent to 40 per cent. Even such figures cannot be determined merely from the results published by the various States, but must be obtained in most cases by an actual examination and compilation from the registration books.

Many States do not segregate car and truck registrations at all. Even in those cases where they do, however, there is a wide variation in definition of what is a car and what is a truck.

Some States register tractors with trucks and do not register trailers; others register trailers with trucks and do not register tractors; others register both tractors and trailers with trucks, and still others register neither trailers nor tractors in any way. These facts should be borne in mind when any calculations are being made on the basis of apparently segregated registrations.

It is the practice in some States, as well, to classify vehicles on the basis of use rather than construction.

Detailed and useful segregation of motor vehicle registrations is being made in several States at present, notably Oregon, New York and Michigan. But even in these cases the practice is not uniform among the three.

The industry will never be able to obtain the maximum benefit from registration figures until there is a uniform registration law throughout the country. There are already samples of valuable and sound practice, but such practice is not at all universal. Moreover, uniformity is necessary as well as essential soundness. A detailed outline for the best method of segregating and compiling motor vehicle registrations would be a worth-while addition to the Uniform Motor Vehicle Law, which many automotive interests throughout the country are now supporting.

The foregoing explanation indicates the reason for compiling a table of persons per motor vehicle rather than two tables of persons per car and persons per truck. It can't be done with any degree of accuracy at the present time. The tables used, however, do give a comparative evaluation from year to year.

In the major table, "total net registration" includes only cars and trucks. It does not include motorcycles.

MOTOR VEHICLE REGISTRATION 1912 TO 1921.

	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921
Alabama.....	3,385	5,435	8,078	11,925	21,636	32,873	46,171	58,898	74,637	82,343
Arizona.....	1,624	3,098	5,040	7,318	12,124	19,890	23,909	28,979	34,559	35,049
Arkansas.....	2,250	3,000	5,642	8,021	15,000	28,693	41,458	49,450	59,082	67,446
California.....	88,699	60,000	123,516	163,795	232,440	306,916	364,800	477,450	568,892	673,830
Colorado.....	8,950	13,135	17,756	27,568	43,296	66,850	83,630	104,865	128,951	145,739
Connecticut.....	24,101	27,189	33,009	43,985	61,855	85,724	92,605	109,651	119,134	137,526
Delaware.....	1,732	2,350	3,050	4,657	7,102	10,700	12,955	16,152	18,300	21,413
District of Columbia.....	1,732	2,372	3,483	8,009	13,118	15,493	30,486	35,400	73,914	61,745
Florida.....	1,749	2,372	3,368	10,850	27,000	47,579	54,180	55,400	73,914	97,837
Georgia.....	19,120	18,500	20,916	25,671	47,579	70,357	99,800	127,326	144,422	131,942
Idaho.....	2,500	2,173	3,346	7,071	12,999	24,731	32,289	42,220	50,873	51,294
Illinois.....	68,073	94,656	131,140	180,832	248,420	390,292	478,438	568,759	670,434	760,342
Indiana.....	54,334	47,000	66,400	96,915	139,317	192,192	227,160	277,255	332,707	400,342
Iowa.....	47,188	75,088	112,134	152,134	198,602	254,317	278,313	363,857	437,300	460,528
Kansas.....	22,000	34,366	49,374	72,520	112,122	159,343	189,163	227,752	265,396	291,309
Kentucky.....	5,147	7,210	11,746	19,500	31,700	47,416	65,870	90,641	112,685	126,371
Louisiana.....	7,000	7,200	12,000	11,380	17,000	28,394	40,000	50,600	66,000	80,500
Maine.....	7,743	10,570	15,700	21,545	30,972	41,499	40,372	53,425	62,907	77,527
Maryland.....	10,487	14,254	20,213	31,047	44,245	60,943	74,666	95,634	116,341	140,572
Massachusetts.....	50,132	62,660	77,246	102,633	136,809	174,274	193,497	247,183	304,631	360,732
Michigan.....	39,579	54,366	76,389	114,845	160,052	247,006	262,125	325,813	412,717	477,037
Minnesota.....	29,000	37,800	57,862	93,269	146,000	254,000	204,458	259,743	355,517	477,037
Mississippi.....	2,895	3,000	5,964	9,669	25,000	36,600	48,400	45,030	63,484	65,139
Missouri.....	24,379	38,140	54,468	76,462	103,587	147,578	188,040	244,363	296,919	346,437
Montana.....	2,000	5,686	10,172	14,499	24,440	42,696	51,037	59,325	60,646	58,785
Nebraska.....	33,861	25,617	40,929	59,140	100,534	148,101	175,409	192,000	223,000	238,704
Nevada.....	900	1,131	1,487	2,009	4,919	9,160	15,159	9,305	10,464	10,819
New Hampshire.....	5,764	7,420	9,571	13,499	17,508	22,267	24,817	31,625	34,680	42,039
New Jersey.....	43,056	48,892	60,247	78,232	104,332	134,964	155,519	190,873	227,787	272,994
New Mexico.....	911	1,721	2,945	5,100	8,228	15,000	18,077	21,109	24,703	24,703
New York.....	107,262	134,405	169,966	234,032	317,866	411,567	463,758	571,662	666,200	812,031
North Carolina.....	6,178	10,000	15,671	21,908	33,904	53,950	72,313	109,017	140,860	148,684
North Dakota.....	13,075	13,075	15,701	24,908	40,446	62,993	71,627	82,985	90,840	97,644
Ohio.....	63,066	80,054	122,504	181,332	252,431	346,772	412,775	511,031	613,397	720,632
Oklahoma.....	6,524	13,934	13,504	25,032	52,718	100,192	131,500	184,900	204,300	221,320
Oregon.....	10,165	13,957	16,447	23,585	32,917	48,632	63,324	83,332	103,790	118,325
Pennsylvania.....	58,357	76,178	119,854	160,187	230,578	325,153	394,186	482,117	570,164	689,869
Rhode Island.....	8,365	10,594	12,331	19,362	21,406	33,049	36,218	44,833	50,375	54,557
South Carolina.....	10,000	11,500	14,500	19,500	25,500	35,500	45,500	55,500	65,500	75,500
South Dakota.....	14,481	14,578	20,029	25,784	44,271	61,138	80,521	104,628	120,393	119,274
Tennessee.....	35,187	54,362	74,769	90,000	197,687	245,000	331,510	401,852	427,693	467,616
Texas.....	35,187	54,362	74,769	90,000	197,687	245,000	331,510	401,852	427,693	467,616
Utah.....	2,576	4,021	2,253	9,177	13,507	24,076	23,118	33,510	42,578	47,423
Vermont.....	4,283	5,918	8,256	11,499	15,671	20,369	22,655	26,807	31,625	36,965
Virginia.....	9,760	9,022	14,002	21,357	35,426	51,077	62,723	72,278	84,120	94,120
Washington.....	13,990	24,178	30,253	38,823	60,734	91,337	117,278	148,775	173,920	181,000
W. Virginia.....	5,349	3,088	6,159	13,279	20,571	31,300	38,570	50,203	78,862	93,894
Wisconsin.....	24,578	34,646	53,161	79,791	115,637	164,531	196,844	236,981	293,298	341,841
Wyoming.....	1,300	1,584	2,428	3,976	7,125	12,523	16,200	21,371	23,926	26,619
Totals.....	1,033,096	1,287,558	1,768,720	2,479,742	3,584,567	4,992,152	6,105,974	7,596,503	8,932,458	10,505,660

\* Estimated.



### Motorcycles Drop

Motorcycle registration took a decided fall during 1921, when 27,024 less machines were registered than in 1920. The motorcycle total for 1921 was 207,930, a drop of 11.54 per cent as compared with the previous year.

### Persons Per Car

Iowa has taken the lead in having the lowest number of persons per car. Its superiority over South Dakota in this respect, however, is so small as to be almost negligible. Iowa, South Dakota, Nebraska and California, in fact, are all very closely bunched, the difference being extremely slight.

Indiana is the first of the manufacturing States to appear in this list, followed by Wisconsin and Michigan. The first five manufacturing States rank as follows:

Indiana . . . . .	7.41
Wisconsin . . . . .	7.84
Michigan . . . . .	7.97
Ohio . . . . .	8.20
Illinois . . . . .	9.87

### OWNERSHIP OF CARS AND TRUCKS BY COUNTRIES

Algeria . . . . .	12,000	Indo China . . . . .	2,300
Angola . . . . .	250	Italian Somaliland . . . . .	66
Argentina . . . . .	75,000	Italy . . . . .	53,000
Australia . . . . .	73,900	Jamaica . . . . .	1,350
Austria . . . . .	16,350	Japan . . . . .	12,260
Azores . . . . .	80	Madagascar . . . . .	159
Bahama . . . . .	150	Madeira Islands . . . . .	100
Barbados . . . . .	1,000	Mauritius Island . . . . .	1,600
Belgium . . . . .	33,200	Mexico . . . . .	25,000
Bolivia . . . . .	300	Monrovia . . . . .	3
Brazil . . . . .	25,000	Morocco . . . . .	2,500
British Guiana . . . . .	1,050	New Foundland . . . . .	600
British Honduras . . . . .	68	New Zealand . . . . .	37,500
British West Africa . . . . .	566	Nicaragua . . . . .	370
Canada . . . . .	463,448	Norway . . . . .	14,340
Canary Islands . . . . .	881	Panama . . . . .	1,950
Ceylon . . . . .	5,350	Paraguay . . . . .	500
Czechoslovakia . . . . .	4,133	Peru . . . . .	3,343
Chile . . . . .	10,000	Philippine Islands . . . . .	12,381
China . . . . .	8,150	Poland . . . . .	10,700
Colombia . . . . .	2,000	Porto Rico . . . . .	6,500
Costa Rica . . . . .	200	Portugal . . . . .	5,000
Cuba . . . . .	20,000	Portuguese East Africa . . . . .	400
Denmark . . . . .	22,260	Reunion Island . . . . .	35
Dominican Republic . . . . .	1,800	Roumania . . . . .	8,500
Dutch East Indies . . . . .	45,000	Russia . . . . .	35,000
Ecuador . . . . .	500	Salvador . . . . .	400
Egypt . . . . .	5,084	Siam . . . . .	2,187
Federated Malay States . . . . .	8,000	Spain . . . . .	37,560
France . . . . .	236,146	Sweden . . . . .	14,250
French West Africa . . . . .	230	Switzerland . . . . .	18,011
Germany . . . . .	91,384	Trinidad . . . . .	2,221
Gold Coast . . . . .	3,500	Tunis . . . . .	1,990
Great Britain . . . . .	497,582	Turkey . . . . .	5,500
Guadeloupe . . . . .	500	Union of South Africa . . . . .	26,468
Guatemala . . . . .	500	United States . . . . .	10,505,660
Hawaii . . . . .	1,500	Uruguay . . . . .	10,000
Holland . . . . .	13,500	Venezuela . . . . .	2,500
Honduras . . . . .	200		
India . . . . .	45,983		12,588,949

There are no manufacturing States included in the first ten of this list, nor are there any of the southern States in this charmed circle of ten. There are six agricultural States, two mining States and two—California and District of Columbia—not included in the arbitrary classification used here.

In certain instances the number of persons per car was higher in 1921 than in 1920. This is due to the fact that the population has increased at a greater rate than has registration during the last year.



## STATE AND COUNTY HIGHWAY BOND ISSUES

**H**IGHWAY bonds amounting to \$999,547,640 were authorized by the various States and counties between January 1, 1919, and December 31, 1921, including State bond issues in Illinois and Pennsylvania authorized during 1918. On January 30, 1922, the State of Alabama authorized \$25,000,000, which brings the total to \$1,024,547,640. A large portion of this money is available for expenditure during the next two or three years.

A list of these issues compiled by the Portland Cement Association is shown as follows. The county issues authorized in 1919 and 1920 are summarized, but the names of the counties in which the issues were authorized may be obtained from previous issues of the HIGHWAYS GREEN BOOK.

	<i>Amount Authorized</i>	<i>Totals</i>	<i>1921 Date Authorized</i>
<b>ALABAMA</b>			
1920: 2 Counties.....	\$ 5,450,000		
1921: Madison County.....	200,000		May
Mobile County.....	250,000		April 26
Pickens County.....	200,000		July
Total	-----	\$ 6,100,000	
<b>ARIZONA</b>			
1919: 9 Counties.....	\$ 8,800,000		
1920: 1 County.....	4,500,000		
Total	-----	\$13,300,000	
<b>ARKANSAS</b>			
1919: 3 Counties.....	\$ 4,900,000		
Total	-----	\$ 4,900,000	
<b>CALIFORNIA</b>			
1919: State.....	\$40,000,000		
18 Counties.....	28,435,000		
1920: 1 County District.....	400,000		
1921: Santa Cruz County.....	209,000		Aug. 9
Total.....	-----	\$69,044,000	
<b>COLORADO</b>			
1920: State.....	\$ 5,000,000		
Total.....	-----	\$ 5,000,000	
<b>CONNECTICUT</b>			
1921: Fairfield County,			
Norwalk Township.....	\$ 35,000		Jan 4
Total.....	-----	\$ 35,000	
<b>DELAWARE</b>			
1919: 1 County.....	\$ 500,000		
1920: 2 Counties.....	1,540,000		
Total.....	-----	\$ 2,040,000	

		<i>Amount Authorized</i>	<i>Totals</i>	<i>1921 Date Authorized</i>
<b>FLORIDA</b>				
1919:	7 Counties.....	\$ 2,615,000		
1920:	2 Counties.....	2,350,000		
1921:	Bradford County.....	500,000		Oct. 1
	Cherokee County.....	450,000		July
	Lake County.....	600,000		June
	Orange County.....	2,350,000		Aug. 13
	Total.....		\$ 8,865,000	
<b>GEORGIA</b>				
1919:	41 Counties.....	\$15,375,000		
1921:	Floyd County.....	750,000		June
	Walker County.....	400,000		
	Total.....		\$16,525,000	
<b>IDAHO</b>				
1919:	21 Counties.....	\$ 7,873,000		
1920:	State.....	2,000,000		
	11 Counties.....	1,832,000		
	Total.....		\$11,705,000	
<b>ILLINOIS</b>				
1918:	State.....	\$60,000,000		
1919:	12 Counties.....	8,992,845		
1920:	6 Counties.....	2,043,500		
	Total.....		\$71,036,345	
<b>INDIANA</b>				
1920:	1 County.....	\$ 860,000		
	Total.....		\$ 860,000	
<b>IOWA</b>				
1919:	13 Counties.....	\$18,475,000		
	Total.....		\$18,475,000	
<b>KANSAS</b>				
1919:	1 County.....	\$ 50,000		
	Total.....		\$ 50,000	
<b>KENTUCKY</b>				
1919:	9 Counties.....	\$ 2,730,000		
1920:	1 County.....	100,000		
1921:	Kenton County.....	500,000		Nov. 8
	Martin County.....	200,000		
	Magoffin County.....	125,000		
	Montgomery County.....	250,000		May 28
	Menifee County.....	60,000		
	Total.....		\$ 3,965,000	
<b>LOUISIANA</b>				
1919:	31 Parishes.....	\$11,946,000		
1920:	2 Parishes.....	917,000		
1921:	Morehouse Parish.....	1,300,000		July 9
	East Baton Rouge Parish	175,000		
	Total.....		\$14,338,000	
<b>MAINE</b>				
1919:	State.....	\$ 8,000,000		
1920:	1 County.....	73,000		
	Total.....		\$ 8,073,000	
<b>MARYLAND</b>				
1920:	State.....	\$ 3,000,000		
	Total.....		\$ 3,000,000	



	<i>Amount Authorized</i>	<i>Totals</i>	<i>1921 Date Authorized</i>
<b>MASSACHUSETTS</b>			
1920: 1 County.....	\$ 22,000		
1921: Hampton County, West Springfield Twp....	20,000		
Total.....		\$ 42,000	Feb.
<b>MICHIGAN</b>			
1919: State.....	\$50,000,000		
6 Counties.....	3,100,000		
1920: 4 Counties.....	650,000		
1921: Houghton County.....	200,000		
Total.....		\$53,950,000	
<b>MINNESOTA</b>			
1919: 17 Counties.....	\$12,800,000		
1920: State.....	75,000,000		
30 Counties.....	4,132,000		
Total.....		\$91,932,000	
<b>MISSISSIPPI</b>			
1919: 54 Counties.....	\$15,848,000		
1920: 2 Counties.....	1,400,000		
1921: Grenada County.....	40,000		
Lee County.....	100,000		
Monroe County.....	100,000		
Neshaha County.....	15,000		
Oktibbeha County.....	80,000		
Quitman County.....	10,000		
Jackson County.....	300,000		
Newton County.....	20,000		
Sunflower County.....	250,000		
Tunica.....	50,000		
Total.....		\$18,213,000	July Aug.
<b>MISSOURI</b>			
1919: 38 Counties.....	\$13,919,600		
1920: State.....	60,000,000		
3 Counties.....	2,340,000		
1921: Lawrence County.....	40,000		
Jasper County.....	40,000		
Total.....		\$76,339,600	
<b>MONTANA</b>			
1919: 34 Counties.....	\$ 6,283,000		
1920: 4 Counties.....	1,000,000		
Total.....		\$ 7,283,000	
<b>NEBRASKA</b>			
1919: 1 County.....	\$ 3,000,000		
Total.....		\$ 3,000,000	
<b>NEVADA</b>			
1919: State.....	\$ 1,000,000		
1 County.....	300,000		
Total.....		\$ 1,200,000	
<b>NEW JERSEY</b>			
1920: State.....	\$29,000,000		
1 County.....	1,000,000		
1921: Monmouth.....	240,000		
Total.....		\$30,240,000	April
<b>NEW MEXICO</b>			
1920: 2 Counties.....	\$ 325,000		
1921: State.....	2,000,000		
Total.....		\$ 2,325,000	Sept. 20

	<i>Amount Authorized</i>	<i>Totals</i>	<i>1921 Date Authorized</i>
<b>NEW YORK</b>			
1920: 12 Counties.....	\$ 1,498,000		
1921: Suffolk County,			
Huntington Twp.....	15,000		Feb.
Westchester County,			
Yonkers Twp.....	26,000		Mar. 23
Onondaga County			
Apulia Twp.....	60,000		July
Chenango County.....	500,000		Dec.
Total.....		\$ 2,099,000	
<b>NORTH CAROLINA</b>			
1919: 52 Counties.....	\$13,459,635		
1920: 1 County.....	2,000,000		
1921: State.....	50,000,000		
Catawba County.....	500,000		
Hertford.....	500,000		
Mecklinberg.....	2,000,000		April 19
Gaston.....	800,000		July 18
Total.....		\$69,259,635	
<b>OKLAHOMA</b>			
1919: 1 Counties.....	\$ 1,158,000		
1920: 5 Counties.....	2,813,000		
1921: Washington County.....	700,000		Oct. 29
Le Flore County.....	800,000		Dec. 29
Pittsburgh County.....	750,000		
Carter County.....	500,000		
Total.....		\$ 6,721,000	
<b>OREGON</b>			
1919: State.....	\$10,000,000		Nov. 15
State—Roosevelt Hwy.....	2,500,000		No election required
25 Counties.....	9,516,704		
State.....	10,000,000		
1920: 5 Counties.....	3,120,000		
1921: Coos County.....	300,000		June 7
Curry County.....	165,000		June 7
Deschutes County.....	50,000		June 7
Douglas County.....	1,110,000		June 7
Grant County.....	440,000		June 7
Lincoln County.....	343,000		June 7
Hood River County.....	350,000		June 7
Wasco County.....	800,000		June 7
Wheeler County.....	140,000		June 7
Total.....		\$38,834,704	
<b>PENNSYLVANIA</b>			
1918: State.....	\$50,000,000		
1919: 26 Counties.....	13,320,288		
1920: 19 Counties.....	17,854,568		
1921: Clearfield County:			
Sandy Twp.....	70,000		
Huston Twp.....	50,000		
Mercer County.....	1,300,000		
Bedford County,			
Bedford Twp.....	200,000		April
Tioga County,			
Millertown Twp.....	40,000		June
Luzerne County.....	155,000		June
Total.....		\$82,928,856	



	<i>Amount Authorized</i>	<i>Totals</i>	<i>1921 Date Authorized</i>
<b>SOUTH CAROLINA</b>			
1919: 14 Counties.....	\$ 8,560,000		
1920: 3 Counties.....	5,900,000		
1921: Florence County.....	100,000		
York County.....	75,000		
Charleston County.....	1,000,000		
Total.....		\$15,635,000	Nov. 22
<b>SOUTH DAKOTA</b>			
1919.....	\$ 4,500,000		
Total.....		\$ 4,500,000	
<b>TENNESSEE</b>			
1919: 32 Counties.....	\$ 7,385,000		
1920: 4 Counties.....	1,770,000		
Total.....		\$ 9,155,000	
<b>TEXAS</b>			
1919: 119 Counties.....	\$88,908,000		
1920: 34 Counties.....	8,864,000		
1921: Angelina County.....	1,142,500		
Road Dist. No. 7.....	20,000		
Chambers County,			
Road Dist. No. 2.....	60,000		
Cherokee County,			
Road Dist. No. 1.....	450,000		
Collin County.....	50,000		
Fayette County.....	100,000		
Foard County.....	150,000		
Guadalupe County,			
Road Dist. No. 5.....	65,000		
Hemphill County.....	50,000		
Hidalgo County.....	1,250,000		
Jackson County.....	60,000		
Jefferson County.....	2,000,000		
Lamb County,			
Road Dist. Nos. 1 and 2.	50,000		
Newton,			
Road Dist. No. 1.....	200,000		
Road Dist. No. 3.....	100,000		
Palo Pinto County,			
Road Dist. No. 1.....	1,000,000		
Reeves County,			
Road Dist. No. 1.....	100,000		
Road Dist. No. 2.....	40,000		
Robertson County,			
Road Dist. No. 7.....	150,000		
Runnels County,			
Winters District.....	40,000		
Wilbarger.....	600,000		
Wise,			
Road Dist. No. 2.....	150,000		
Total.....		\$105,599,500	
<b>UTAH</b>			
1919: State.....	\$ 4,000,000		
4 Counties.....	2,766,000		
1920: 6 Counties.....	778,500		
1921: Cache County.....	600,000		June 7
Carbon County.....	190,000		May 14
Juah County.....	225,000		June 7
Total.....		\$ 8,559,500	

	<i>Amount Authorized</i>	<i>Totals</i>	<i>1921 Date Authorized</i>
<b>VERMONT</b>			
1920: 1 County.....	\$ 75,000		
Total.....		\$ 75,000	
<b>VIRGINIA</b>			
1920: State.....	Amount not fixed		Nov. 2, 1920
1921: Albemarle County.....	\$ 700,000		
Henry County.....	125,000		June 28
Total.....		\$ 825,000	
<b>WASHINGTON</b>			
1919: 8 Counties.....	\$ 9,535,000		
1920: 2 Counties.....	468,000		
Total.....		\$10,003,000	
<b>WEST VIRGINIA</b>			
1919: 19 Counties.....	\$ 8,426,000		
1920: State.....	50,000,000		
14 Counties.....	4,329,500		
Total.....		\$62,755,500	
<b>WISCONSIN</b>			
1919: 18 Counties.....	\$36,755,000		
1920: 6 Counties.....	636,000		
Total.....		\$37,391,000	
<b>WYOMING</b>			
1919: State.....	\$ 2,800,000		
1921: State.....	1,800,000		May 10
Total.....		\$ 4,600,000	
Total authorized to December 31, 1919.	\$608,432,072		
Total authorized to December 31, 1920.	305,041,068		
Total authorized to December 31, 1921.	86,074,500		
Grand total authorized		\$999,547,640	

## Organized Highways of National and Interstate Importance

### Transcontinental Highway Organizations

- Bankhead Highway*—Benehan Cameron, Pres., Raleigh, N. C.; J. A. Rountree, Secy., 1021 Brown-Marx Bldg., Birmingham, Ala. Washington, D. C., to San Diego, Cal.
- Dirie Highway*—M. M. Allison, Pres.; Miss M. B. Roberts, Secy., Hotel Patten, Chattanooga, Tenn. Sault Ste. Marie, Mich., to Miami, Fla.
- Dirie-Overland Highway*—Col. Edward Fletcher, Pres., San Diego, Cal.; Leland J. Henderson, Secy., Columbus, Ga. Savannah, Ga., to San Diego, Cal.
- Evergreen National Highway*—F. H. Sweetland, Pres.; S. E. Brokaw, Secy., Tacoma, Wash. Victoria, B. C., to El Paso, Texas.
- George Washington National Highway*—F. A. Wells, Pres.; W. B. Cheek, Secy., 315 Exchange Bldg., Union Stock Yards, Omaha, Nebr. Seattle, Wash., to Savannah, Ga.
- International Peace Highway*—Thad Snow, Pres., Charleston, Mo.; Eugene Stuart, Secy., Louisville, Ky. Quebec, Canada and Rouses Point, N. Y., to Laredo, Texas, and Mexico City, Mexico.
- Jackson Highway*—P. L. Atherton, Pres.; Dr. R. R. Elmore, Secy., Lincoln Bldg., Louisville, Ky. Chicago, Ill., to New Orleans, La.
- Jefferson Highway*—Walter Parker, Pres., New Orleans, La.; J. D. Clarkson, Gen. Mgr., St. Joseph, Mo. Winnipeg, Can., to New Orleans, La.
- King of Trails*—W. W. Brown, Pres.; Ernest E. Pratt, Gen. Mgr., Pearson, Kans. Winnipeg, Can., to Galveston, Tex.
- Lakes to Gulf Highway*—C. F. Adams, Pres.; Harry W. Graham, Secy.-Treas., Chillicothe, Mo. Duluth, Minn., to Galveston, Tex.



- Lee Highway*—C. H. Huston, Pres.; Dr. S. M. Johnson, General Director, 724 Albee Bldg., Washington, D. C. Washington, D. C., to San Diego, Cal.
- Lincoln Highway*—J. N. Gunn, Pres.; A. F. Bement, Vice-Pres. and Secy.; G. S. Hoag, Field Secy., Garfield Bldg., Detroit, Mich. New York to San Francisco.
- Lone Star Route*—Col. A. L. Carter, Pres., Medora, Ill.; H. C. Wilhite, Secy.-Mgr., 2621 College Ave., Alton, Ill. Chicago, Ill., to Brownsville, Tex.
- Meridian Highway*—J. C. Nicholson, Pres., Newton, Kan.; G. A. MacNaughton, Secy., San Marcos, Tex. Winnipeg, Can., to Laredo, Tex.
- Mississippi River Scenic Highway System*—C. E. Lightfoot, Pres., St. Louis, Mo.; Truman Pierson, Gen. Mgr., 805 Lumber Exchange, Minneapolis, Minn. Winnipeg, Can., to New Orleans, La., and Tampa, Fla.
- Mississippi Valley Highway* (formerly Burlington Way)—Cliff Williams, Pres., Meridian, Miss.; J. C. Reintges, Secy., Granite City, Ill. Duluth, Minn., to New Orleans, La.
- National Old Trails Road*—J. M. Lowe, Pres., Railway Exchange Bldg., Kansas City, Mo.; Frank Davis, Secy., Rose-dale, Kan. Washington, D. C., to Los Angeles, Cal.
- Old Spanish Trail*—Dr. Fred B. Johnston, Pres.; H. B. Ayers, Mgr.-Director, San Antonio, Tex. St. Augustine, Fla., to San Diego, Cal.
- Pacific Highway*—Samuel Hill, Pres., Maryhill, Wash.; Frank M. Fretwell, Secy., Seattle, Wash. Vancouver, B. C., to San Diego, Cal.
- Pershing Way*—C. H. Draper, Pres., Wells, Minn.; Herbert F. McDougal, Secy.-Mgr., Cedar Falls, Ia. Winnipeg, Can., to New Orleans, La.
- Pike's Peak Ocean-to-Ocean Highway* (Pershing Transport Route)—C. F. Adams, Pres., Chillicothe, Mo.; J. D. Clarkson, Gen. Mgr., St. Joseph, Mo.; E. E. Jackson, Secy., Colorado Springs, Colo. New York to San Francisco.
- Roosevelt National Highway* (Midland Trail)—Wm. W. Armstrong, Pres., Rochester, N. Y.; J. Y. McClintock, Secy., Rochester, N. Y. Oyster Bay, N. Y., to Los Angeles, Cal.
- Theodore Roosevelt International Highway*—E. J. Filiatrault, Pres.; A. W. Tracy, Gen. Secy.; A. O. Grover, Treas., Duluth, Minn. Portland, Me., to Portland, Ore.
- Victory Highway*—George M. Stansfield, Pres.; Ben Blow, Mgr., Topeka, Kans. New York to San Francisco.
- Yellowstone Trail*—Ray Smith, Pres., Milwaukee, Wis.; H. O. Cooley, Gen. Mgr.; B. R. Mendel, Secy., Minneapolis, Minn. Plymouth, Mass., to Seattle, Wash.

### Interstate Highway Organizations

- Albert Pike Highway*—Cyrus S. Avery, Pres.; E. B. Guthrey, Secy., Tulsa, Okla. Hot Springs, Ark., to Colorado Springs, Colo.
- Arrowhead Trail*—M. P. Chubb, Pres., Redlands, Cal.; F. V. Owen, Secy., 858 Figueroa St., Los Angeles, Cal. Los Angeles, Cal., to Salt Lake City, Utah.
- Ben Hur Highway*—Harry W. Graham, Pres., Chillicothe, Mo.; C. A. Stoner, Secy.-Treas., Ridgeway, Mo. St. Louis, Mo., to Fort Dodge, Iowa.
- Blackhawk Highway*—Malcolm MacKinnon, Secy., Nelson Hotel, Rockford, Ill. Beloit, Wis., to Dixon, Ill.
- Capital Route*—E. Bee Guthrey, Pres., Tulsa, Okla.; A. J. Collins, Secy., Sabetha, Kans. Omaha, Nebr., to Austin, Texas.
- Chicago, Kansas City and Gulf Highway*—Robert N. Carson, Pres., Iowa City, Iowa; Harry W. Graham, Secy., Chillicothe, Mo. Chicago, Ill., to Galveston, Tex.
- Cornhusker Highway*—G. E. Condra, Pres.; L. W. Chase, Secy., Lincoln, Nebr. Sioux City, Iowa, to Oklahoma City, Okla.
- Custer Battlefield Highway*—W. H. Wallace, Pres.; W. D. Fisher, Secy., Sheridan, Wyo. Omaha, Nebr., to Glacier National Park, Mont.
- Dallas-Canadian-Denver Highway*—D. J. Young, Pres.; W. A. Palmer, Secy., Canadian, Texas. Galveston, Texas, to Boulder, Colo.
- Detroit-Lincoln-Denver Highway*—C. H. Roper, Pres.; O. M. Parke, Secy.-Treas., Lincoln, Nebr.
- Geysers-to-Glaciers Highway*—M. Max Goodsell, Secy., Helena, Mont. Yellowstone to Glacier Parks.
- Grant Highway*—Malcolm MacKinnon, Secy., Nelson Hotel, Rockford, Ill. Chicago, Ill., to Portland, Ore.
- Lackawanna Trail*—D. L. Morgan, Pres.; Mark Edgar, Secy., Scranton, Pa. Delaware, N. J., to Binghamton, N. Y.
- Lewis and Clark Highway*—M. J. Carigan, Seattle, Pres.; Robert F. Savage, Lewiston, Ida., Secy. Lewiston, Ida., to Missoula, Mont.
- Logan-Lee Highway*—Geo. H. Goodall, Pres.; Kirby Smith, Secy., Mt. Vernon, Ill. Rock Island, Ill., to Paducah, Ky.
- National Midland Trail, Eastern Division*—Dr. R. R. Elmore, Pres.; Eugene Stuart, Secy., Louisville, Ky. East St. Louis, Ill., to Washington, D. C.
- National Park-to-Park Highway*—Scott Leavitt, Pres., Great Falls, Mont.; Gus Holm's, Managing Secy., 1608 Broadway, Denver, Colo. Circuit of National Parks.
- Ozark Trails*—J. E. Swepston, Pres.; C. L. Cooper, Secy., Tulsa, Texas. Kansas City, Hannibal, St. Louis, and Memphis, to Denver, Las Vegas, and El Paso.
- River-to-River Road*—L. V. Russell, Pres.; E. H. Spaulding, Secy.-Treas., Grinnell, Iowa. Davenport, Iowa, to Omaha, Nebr.
- South West Trail*—C. M. McFatrige, Pres., Monrovia, Iowa; Frank A. Davis, Gen. Mgr., 120 W. 10th St., Kansas City, Mo. Chicago, Ill., to El Paso, Texas.

*White River Trail*—E. Bee Guthrey, Pres., Tulsa, Okla.; J. E. Mann, Secy., Locust Grove, Okla. Springfield, Mo., to Ponca City, Okla.

*Yellowstone Highway*—L. L. Newton, Pres.; Gus Holm's, Secy., Cody, Wyo. Denver, Colo., to Yellowstone National Park.

### National Highways and Affiliated Organizations

*Advisory Board on Highway Research of the National Research Council*—Chairman, Dean A. Marston; Alfred D. Flinn, Vice-Chairman, acting as Secy., 29 W. 39th St., New York City; Dr. H. K. Hatt, Director of Highway Research, 1701 Mass. Ave. N. W., Washington, D. C.

*American Association of State Highway Officials*—Pres., C. M. Babcock, St. Paul, Minn.; C. M. Upham, Secy., Raleigh, N. C.

*American Road Builders' Association*—H. L. Bowlby, Pres., Willard Bldg., Washington, D. C.; James H. Macdonald, Treas., New Haven, Conn.; E. L. Powers, Secy., 11 Waverly Place, New York City.

*Associated Highways of America*—Cyrus Avery, Pres., Tulsa, Okla.; Frank A. Davis, Secy., 120 W. 10th St., Kansas City, Mo.

*National Grange*—Prof. Thos. C. Atkeson, National Legislative Representative, 630

Louisiana Avenue, N. W., Washington, D. C.

*National Highway Traffic Association*—Arthur H. Blanchard, Pres., University of Michigan, Ann Arbor, Mich.; Elmer Thompson, Secy., 247 W. 54th St., New York City, N. Y.

*National Highways Association*—Chas. Henry Davis, Pres., Bass River, Cape Cod, Mass.

*National Park Touring Association*—Gus Holm's, Pres.; L. L. Newton, Secy., Cody, Wyo.

*National Safety Council*—A. H. Young, Pres.; W. H. Cameron, Exec. Secy., 168 N. Michigan Ave., Chicago, Ill.

*Pacific Northwest Tourist Association*—W. J. Hofmann, Pres., Portland, Ore.; Herbert Cuthbert, Secy., L. C. Smith Bldg., Seattle, Wash.

*United States Good Roads Association*—Chas. H. Brough, Pres.; J. A. Rountree, Secy., Brown-Marx Bldg., Birmingham, Ala.

### State Highway Associations

*Alabama Good Roads Association*—Hon. John Craft, Pres.; J. A. Rountree, 1021 Brown-Marx Bldg., Birmingham, Ala.

*Arizona Good Roads Association*—O. C. Parker, Pres., Tucson, Ariz.; Harry Welch, Secy., Phoenix, Ariz.

*Central Florida Highway Association*—T. Ed. Bryan, Pres.; L. P. Dickie, Secy., Tampa, Fla.

*Southeastern Idaho Good Roads Association*—Theodore Turner, Pres., Pocatello, Idaho.

*Illinois Association for Highway Improvement*—W. G. Edens, Pres., 125 W. Munroe St., Chicago, Ill.

*Kansas Good Roads Association*—W. S. Gibbons, Pres., Meade, Kans.; J. C. Nicholson, Secy., Newton, Kans.

*Massachusetts Highway Association*—David H. Livingston, Pres., Dedham, Mass.; John M. McCarthy, Secy., Room 426 State House, Boston, Mass.

*Michigan Pikes Association*—Capt. W. S. Gilbreath, Pres., Hotel Tuller, Detroit, Mich.; Willard K. Bush, Secy., 1220 Book Bldg., Detroit, Mich.

*Michigan State Good Roads Association*—P. T. Colgrove, Pres.; H. G. Hayes, Secy., Hastings, Mich.

*Federated Highways Association of North Missouri*—C. F. Adams, Pres.; Harry W. Graham, Secy.-Treas., Chillicothe, Mo.

*Montana Highway Improvement Association*—Nelson B. Story, Jr., Pres.; J. A. Harader, Secy., Bozeman, Mont.

*Nebraska Good Roads Association*—O. G. Smith, Pres., Kearney, Nebr.; C. H. Roper, Secy., Lincoln, Nebr.

*Nevada Highway Association*—Geo. A. Campbell, Pres.; Carman Jewett Wilkie, Secy., Reno, Nev.

*New Hampshire Good Roads Association*—Winfield M. Chapin, Pres.; Wm. M. Morrison, Secy., Keene, N. H.

*New York Road Builders' Association*—John H. Gordon, Pres.; M. F. Duggan, Secy., Albany, N. Y.

*North Carolina Good Roads Association*—W. C. Boren, Pres., Pomona, N. C.; Miss H. M. Berry, Secy., Chapel Hill, N. C.

*North Dakota Good Roads Association*—I. J. Moe, Pres., Valley City, N. D.; W. E. Holbein, Secy., Bismarck, N. D.

*Ohio Good Roads Federation*—Wm. T. Calderine, Pres., Cincinnati, Ohio; W. A. Alsdorf, Exec. Secy., Hartman Bldg., Columbia, Ohio.

*Virginia Good Roads Association*—Gen. C. C. Vaughan, Jr., Pres.; Franklin Va.; D. B. Ryland, Secy.-Treas., Lynchburg, Va.; V. D. L. Robinson, Exec. Secy., Hotel Murphy, Richmond, Va.

*Washington State Roads Association*—N. B. Coffman Pres., Chehalis, Wash.

*Good Roads Association of Wisconsin*—Chas. C. Jacobus, Pres.; Francis Cannon, Secy., Cantwell Bldg., Madison, Wisc.

*Wisconsin Highway Commissioners' Association*—W. E. Dillon, Secy., Butter-nut, Wis.

*Wyoming Good Roads Association*—L. L. Newton, Pres., Cody, Wyo.; E. L. Emery, Secy.-Treas., Cheyenne, Wyo.

### Foreign Highway Organizations

*Permanent International Association of Roads Congress*—A. Mahieu, Chairman; P. Le Gavrian, Gen'l. Secy., 1 Avenue d'Iena, Paris.

*Canadian Good Roads Association*—Hon. S. J. Latta, Pres.; Geo. A. McNamee, Secy.-Treas., 909 New Birks Bldg., Montreal, Quebec.



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## HOW THE A.A.A. CAN BENEFIT YOU

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**Good Roads.**—The A.A.A. is teaching the public what good roads are, how they are built, and how they benefit the community. Through its publications and its thousands of members, it has explained that bad roads are not merely an inconvenience to a few, but an enormous economic loss to the whole country. It has always supported legislation designed to secure State and National aid in road building. Its State and local units have offered many prizes for good stretches of road, and have erected innumerable signposts and danger signals. The A.A.A. is a member of the International Association of Road Congresses.

**Touring Information.**—Members of the A.A.A. can always obtain exact and detailed information from the national bureaus of the Touring Information Board in Washington, D. C., and New York City, and also from the 400 local clubs, in some of which they have guest privileges. A new branch touring bureau has been established in the New Willard Hotel Lobby where visitors in Washington may secure detailed information. These touring bureaus keep a list of hotels and garages which guarantee to give fair treatment to automobilists.

**Legislation.**—Through its Legislative Board, the A.A.A. has exerted powerful influence on automobile legislation. It has defeated unjust and oppressive laws, and has secured just and reasonable statutes.

**Contests.**—For the benefit of those who enjoy good sport, the A.A.A. has taken charge of racing and endurance contests, and its Contest Board has kept automobile competition clean and honorable.

## WHAT IS THE A.A.A. DOING?

**Striving** for a National or Inter-state road system—since the Federal Aid Road Act was passed Federal funds have been increased from \$85,000,000 in the original bill to a grand total of \$394,000,000, of which \$350,000,000 is distributed among the several States on a basis which requires them to contribute



another \$350,000,000. The remaining \$34,000,000 is being expended on roads in Federal forest reserves and on Indian reservations.

**Developing** and connecting State, County, and market road systems everywhere, besides obtaining smoother and more durable pavements in cities.

**Reducing** road discomforts due to oiling, repairs, and detours, and securing the abolishing of grade crossings.

**Encouraging** comprehensive fiscal policies and carefully designed plans for road maintenance, resurfacing, and snow removal, thereby insuring travelable roads at all seasons and in all political subdivisions. Emphasizing the relation between road travel and tonnage to expenditures, and thus eventually obtaining wider and safer highway surfaces, with greater carrying capacities.

**Advocating** appointment of traffic engineers to control, regulate, and facilitate transportation of all kinds.

**Beautifying** roadsides, planning the connecting of National parks, increasing the establishment of public comfort stations, and making highway travel generally more instructive, more enjoyable, and more extensive.

**Urging** Federal legislation which will make a home State registration tag acceptable the year round in all other States.

**Seeking** uniform traffic laws in all States, including regulation of wheel, axle, and vehicle loads.

**Mapping** all roads and marking more attractively historical places and points of scenic interest.

**Helping** everyone to "See America First."

**Conducting** National touring bureaus in Washington and New York, consultation with which is free to all A.A.A. members.

**Cooperating** with all organizations engaged in roads progress.

**Publishing** a magazine for motor road users.

**Controlling** automobile contests, assuring high standards in all motoring competitions.

**Extending** A.A.A. influence to other countries through membership in the International Touring Alliance and the International Association of Road Congresses, and in many ways laying the foundations for a firm cooperation and cordial friendship with foreign motorists. Clubs in Canada and Mexico are now affiliated with the A.A.A.

**Join your local club if it is affiliated with the national organization. Otherwise join the national body direct.**











